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Readers are especially invited to report their own work—to explain the problems which they solve—so that their magazine may really be an institution for the exchange of ideas of value in the industry.

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For the greater convenience of the reader this index has been made both titular and topical in nature. Original titles of articles have been amplified or condensed for the purposes of the index as seemed best. Nothing has been indexed under "concrete" and nothing under "cement." "Products" is a word used frequently because it covers the whole field of factory-made articles of concrete. Illustrated articles are denoted by an asterisk after the title. Editorials are designated by "E"; articles in the Information and Consultation department by "I-C"; Correspondence department matter by "C" and New Equipment Methods and Materials department articles by "Eq." The months and pages are given.

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ADVERTISERS' NOTICE

Changes in copy and discontinuance orders for January number of CONCRETE-CEMENT AGE must reach this office not later than December 18.

NEW advertising can be accepted as late as January 1.

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Concrete-Cement Age

Vol. III JULY, 1913 No. 1

Editorials

THIS ISSUE of CONCRETE-CEMENT AGE begins the second year and the third volume of the publication in its present form. Beginning a year ago with the consolidation of *Concrete* and *Cement Age*, with which latter *Concrete Engineering* had previously been combined, CONCRETE-CEMENT AGE had a valuable heritage in the support given these three magazines by the industry in which cement is made and used. Besides it had their ideals for usefulness which had given the new magazine the asset of support from readers and advertisers alike.

As twelve numbers of the new magazine have been completed and bound into two rather heavy books and as the first number of the second year goes to the printer, the publishers of CONCRETE-CEMENT AGE feel that by applying every test of effectiveness and usefulness, this is truly the leading magazine of the industry; it is the leading magazine not merely in the fact that it is the biggest. It might be the biggest as a consequence of its being the leading magazine, but it is the leading magazine, we believe, because it comes closest to the firing lines of the industry; it has the splendid aid for which it is always grateful, of the men who do things and whose word is worth something in every line of the cement and concrete field.

And for all of that conviction we are not smug nor satisfied. The industry is a huge, growing one in which no one can feel content with what he knows or has achieved and it is for this magazine to *fill every void.* YOU, the readers of CONCRETE-CEMENT AGE, can make this a better magazine by telling us of the special work on which we are not hitting the mark, or perhaps are not even aiming at the mark. If CONCRETE-CEMENT AGE is not so helpful as you would like it to be, just indicate to us those lines in which it has seemed to fail. It is for the readers to make this magazine—their magazine—a better magazine.

* * *

THE CONSTRUCTION engineers of the large corporations are the men who probably are called upon more than anybody else to determine what construction materials make for economy and efficiency. In other pages of this issue there are described methods by which an industrial company turns out concrete fence posts which are used to surround its works. The panel of the fence so far is of wood picket construction. The construction engineers of this corporation, in talking the matter over, stated that they are working hard to devise a substitute for the wooden panels in between the concrete posts. The panels they are now using require painting, quickly rot and in every way are unsatisfactory. This engineer, in the conversation referred to, summed the entire matter up in the four words "wood is too expensive." To this fact the American people are gradually waking up.

* * *

IN THIS issue an abstract of a paper by Prof. Hatt presents in brief the report of a comprehensive investigation into the qualities of reinforcing steel which has been rolled from railroad rails. This investigation, which was carried out at the request of the Am. Soc. for Testing Materials in order to furnish a basis on which a standard specification for this material could be built, is of special interest, for there has been previously considerable prejudice, to a certain extent unfounded, against this material. Until quite recently, the standard specification of the Am. Soc. for Testing Materials excluded this material altogether on the ground, to a certain extent well taken, that there were not sufficient data on which to base a specification.

Much credit is due the rail steel manufacturers for the earnest and aggressive manner in which they have won recognition for their material, for while there were not so many technical data available covering the material itself, yet the thousands of buildings and structures in which rail-carbon steel had been used stood as a testimonial to the quality of this material; and concrete engineers and constructors the country over were using this without hesitancy as standard reinforcing material. Such extended and satisfactory use of this material called for recognition, and as far as possible, standardization; and the Hatt report brings to the question first hand accurate information.

So much has been written about cement and its qualifying factors as a structural material and so little about the essential features of the steel used in concrete work, that this report is of first investigation on the quality of re-special interest as being practically the inforcing steel.

* * *

Effect of Alkali On Concrete Pipe Just as this issue goes to press we have Technologic Paper No. 12 of the United States Bureau of Standards on: "Action of the Salts in Alkali Water and Sea Water on Cements." This will be covered more fully in another issue but meantime we cannot refrain from quoting one paragraph from the summary as follows:

> Portland cement mortar or concrete, *if porous,*[1] can be disintegrated by the mechanical forces exerted by the crystallization of almost any salt in its pores, if a sufficient amount of it is permitted to accumulate and a rapid formation of crystals is brought about by drying; and as larger crystals are formed by slow crystallization, there would be obtained the same results on a larger scale, but in greater time if slow drying were had. *Porous stone, brick, and other structural materials are disintegrated in the same manner.*[1] Therefore in alkali regions where a concentration of salts is possible, a dense non-porous surface is essential.

* * *

A Ten-ft. Pole On Construction Work It is usual practice in handling concrete work of any size to have the daily work report show the amount of work done each day, and the excavating, centering, steel and concrete are accurately reported in the proper units. In measuring up work for these reports, a 10-ft. pole is very convenient, sufficiently accurate, and economical of time. These poles, purchased at any supply house, are made of a tough light wood, about ⅝-in. square, shellacked and graduated to feet and inches, at least. Some poles carry subdivisions of ½ in. and ¼ in., at least for the first foot. The value of the pole over a tape or a zig-zag rule is that it is rigid and dimensions can be quickly and easily secured.

* * *

Nobility in Concrete Architecture The following paragraph is quoted from a recent address by W. R. Lethaby, F. R. I. B. A., before the Architectural Association of England. One sentence, the one to the effect that concrete can never become a "noble type of architecture" is of interest in that it indicates in what class this architect belongs—that "it can't be done" class, who have gone at every new development in a half-hearted and wholly skeptical manner. The paragraph follows:

> It must be admitted that, notwithstanding its virtues, concrete has certain special defects. Such, for instance, are poor surface and colour and the tendency to crack. The least cracking seems to destroy our pleasure in a fabric which should be continuous as a china vase. Again, concrete construction seems to call for a large supply of commonest labour, a society of navvies organised by gangers. So far as this is necessarily the case, concrete structures can never, I think—however high their functions may be or however perfect their forms—become a noble type of architecture. For I must repeat again and again, a fine architecture is not a question of shapes, but of the quality of the effort that has gone into it over a long space of time. Every phase of art is, so to say, the logic of a principle. Still, even if concrete construction does depend on essentially slave labour, we must do the best we can while continuing to use it.

In the same address Mr. Lethaby points out certain factors in concrete design that are well recognized, such as the use of broad paneled surfaces, rounded corners, sweeping curves, etc. He adds also, a good word for the frank, self-evident use of veneers.

His reference to a possible lack of nobility of concrete design could be refuted by calling attention to work in England—the most recent example of which is the Museum Building at York. Nobility in design should imply genuine fitness, true and long-enduring service and leadership. Apply these requirements to a concrete arch bridge with its sweeping curves, and homogeneous construction, to any of the church structures which have been built recently with an eye to a true interpretation of concrete as a structured material, apply them even to our modern loft and factory buildings and it will be seen that in fireproof qualities, in maximum "day lighting" facilities, in comfort and safety, they are noble in design and construction.

Ideas of the nobility of men or things have probably changed considerably within the last 100 years. Today, concrete offers, in construction and design, much that is noble.

* * *

Cleveland Tests Show Value of Power Tamping Manufacturers of concrete block should be interested in the report of the Cleveland Building Commission on the relative properties of machine-tamped and hand-tamped concrete block. Machine-tamped block selected at random from Cleveland plants, showed an average absorption under test of 5.57% in 48 hrs., while hand-tamped block, selected and tested under the same conditions, showed an average absorption of 8.04% in the same length of time. Power-tamped block developed an average resistance to crushing of 1,046 lbs. per sq. in., while the average for hand-tamped block was 815 lbs. per sq. in. These tests seem to indicate that power tamping makes a block about 25% better from the standpoints of impermeability and resistance to pressure. It looks as if the mechanical tamper ought to be a good investment for the plant manager who wants to make the best concrete block possible.

The Cleveland tests with steam-curing and air-curing show that the absorption of steam-cured block was about 6.83% and the block developed a resistance to crushing of 867 lbs. per sq. in. Air-cured block showed an absorption of 7.52% and a resistance of 794 lbs. per sq. in. This indicates that steam curing is less essential to the success of a concrete block than is adequate tamping, though curing by steam is without question very much more nearly uniform than air curing can ever be.

The inspectors at Cleveland suggest the advisability of not using lake sand in Cleveland and its vicinity for the reason that the grains are small and of too nearly a uniform size to make the best quality of block.

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Sworn to and subscribed before me this 26th day of June, 1913.

ROY MARSHALL, Notary Public.
(My commission expires February 3, 1917.)

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[1]The italics are ours—EDITORS.

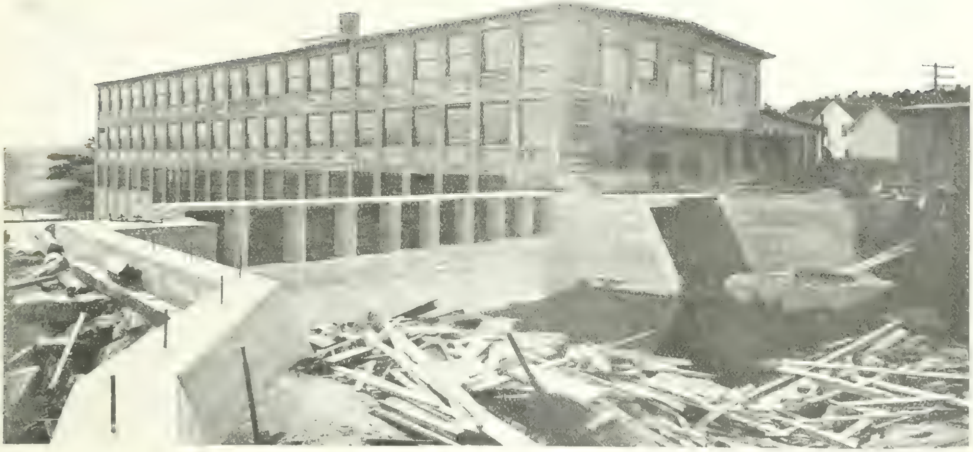


Fig. 1—The New Plant of the Milton Leatherboard Co., Milton, N. H.

Reinforced Concrete in Factory Construction

Some Details of Mill and Dam Work in Reinforced Concrete at Milton, N. H.

Not only is reinforced concrete used throughout for the buildings which house a leatherboard factory and the dam which furnishes the power, but the beater tubs and stock chests also are built of this material.

In 1912, there was constructed by the Milton Leatherboard Co., at Milton, N. H., a new reinforced concrete mill, on the site of the former plant previously destroyed by fire. This mill is located on the west bank of the Salmon Falls River in Milton village, about ¼-mi. below the reservoir dam. Mills of various kinds have occupied this site for a century and at least four are known to have been destroyed by fire. Two wooden mills have been lost by the above company in the past 12 years from fire.

A large proportion of the product manufactured by this company consists of leatherboards, made from leather scrap, used for heeling in the manufacture of shoes. The location of the mill is admirably adapted to this purpose. First, by reason of an excellent water power; second, in having a spur track from the main line of the Boston & Maine R. R. closely paralleling the mill its entire length, and extending past the mill, over a trestle, several hundred feet. This simplifies the handling of raw stock into, and the finished product out of the mill.

Again, the conditions for handling the raw stock to beating engines are exceptionally good, as the beaters are located in the mill basement about 18 ft. below the level of car floor, which is also the level of the first floor of mill. Reinforced concrete runways are placed at each entrance door, three in number, extending across the lean-to section of mill, or stock pit, to the side of the main mill building, with other runways connecting transversely to those, so that stock may be trucked to various points over the stock pit, and dumped to the floor below. As the beating engines are lined up directly in front of the stock pit, the further handling of stock into them is reduced to the minimum.

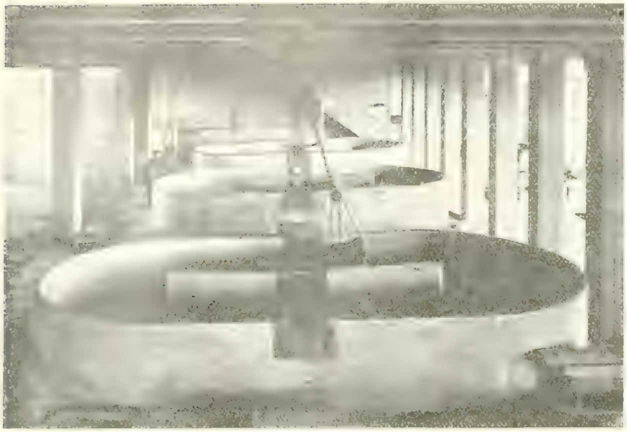
[illegible]

General Layout of Plant

The main building in plan is 183′ 6″ long by 68′ wide, with lean-to over stock pit 118′ long by 38′ wide. Abutting the lean-to on its southerly end, and the main building on its westerly side is the boiler and engine house, 36′ by 32′ in plan. This building is of brick construction and is the original structure which, with its contents, was saved without serious injury from the fire, except the roof, which has now been renewed with reinforced concrete construction.

In elevation the main mill consists of two stories and basement, with sub-basement on the easterly side extending its entire length and 16′ in width. Height from sub-basement floor to top of basement floor is 17′ 6″. Height of basement to top of first floor is 17′ 6″. Height of first and second stories is 12′ 0″ each.

Briefly, the floor construction, in skeleton, consists of a central row of columns, spaced longitudinally 8′ 3″ on centers, with floor beams and rafters spanning right and left to side wall columns. The beams and floor slabs were cast simultaneously, thus forming a monolithic body and producing thereby a T-beam effect. This is also true of the rafters and the roof slab. The wall panels from floors up to window sills are of reinforced concrete and were cast in place



[illegible]

after column forms were removed. All stairways are of reinforced concrete construction. Twisted steel bars were used throughout for reinforcement. The whole structure is founded on solid ledge.

Between the basement and the stock pit, the floors of which are on the same level, all partitions were omitted, leaving an unobstructed pasageway except for the wall columns, and these were cut out below the first floor level wherever they would otherwise have been directly in front of the beating engines, the remaining sections being supported by longitudinal beams spanning between the full height wall columns next in line.

Stock Chests of Concrete

In the sub-basement are installed five circular reinforced concrete stock chests 12′ 0″ in diameter by 15′ 0″ deep. All are equipped with agitators whose shafts extend up through bearings placed in the basement floor slab to a horizontal

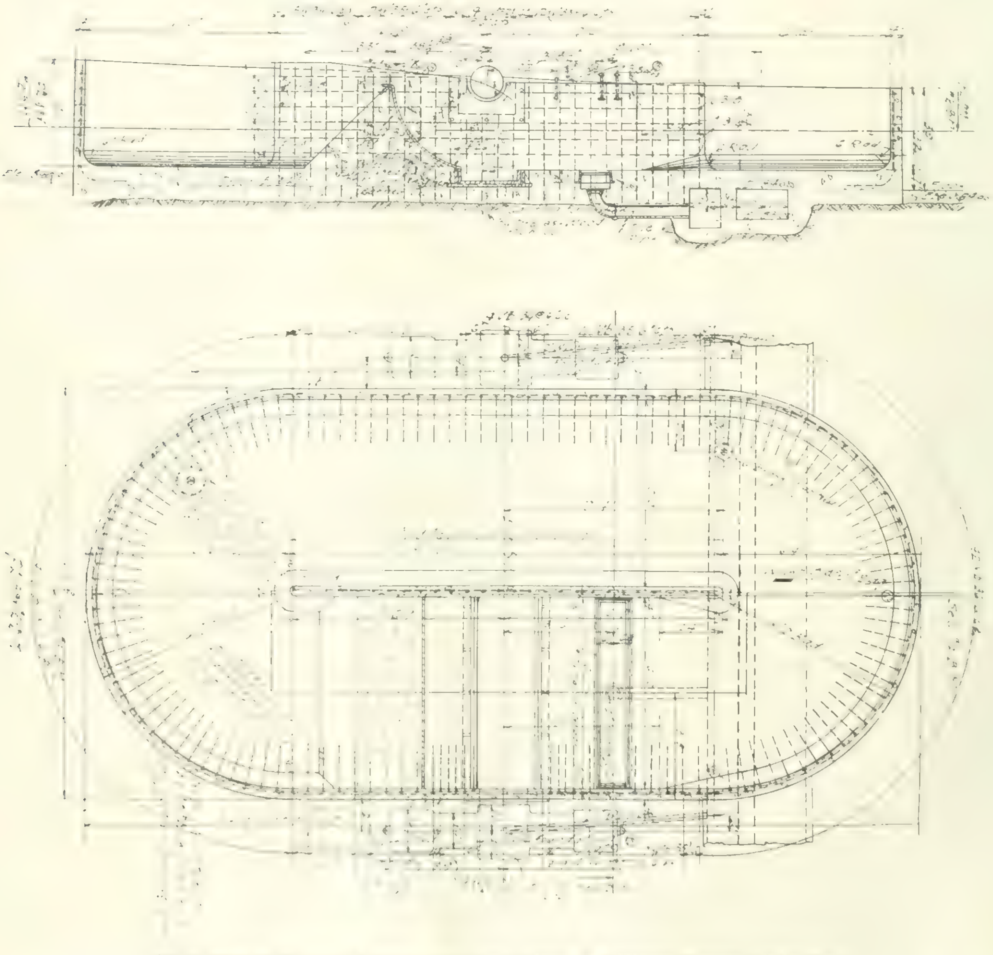
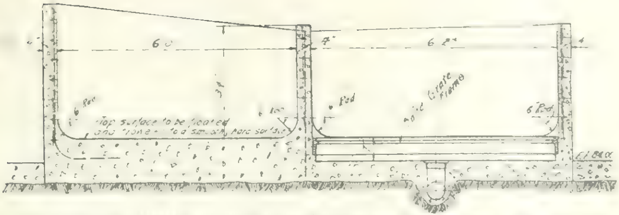


FIG. 4 — [illegible] STRUCTURAL DETAILS OF REINFORCED CONCRETE BEATER TUBS


6 0
6 2
Top surface to be floated and stoned to a smooth hard surface
Rod
Grate Frame
6 Rod

[illegible]

shaft, supported by hangers on harness work, secured to floor beams overhead in basement, where they are operated by bevel gearing.

At the southerly, or downstream end, of the sub-basement two conical reinforced concrete settling tanks are located, the purpose of which is to reclaim all of the waste stock which may escape the wet machines, or from any other cause, in the process of manufacture.

The upstream end, adjacent to fore bay, is occupied by the waterwheel case, main driving pulley, fire pump, etc.

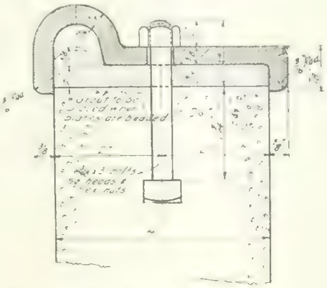
In the basement are located the beating engines, wet machines, electric generator, service pumps and all of the shafting required in the mill.

The first story will be used for finishing, shipping and storage. From this floor connection is made with a room over the boiler and engine rooms, in that building, which will serve as a repair shop, and is equipped with a small motor for driving the necessary machinery for that purpose.

The second, or top story of the mill, is entirely devoted to the process of drying the leatherboard, it being conveyed on trucks, by elevator, directly to this floor, after coming off the wet machines.

In the process of drying, six large rotary exhaust fans will be used, which are set in circular apertures provided in end walls of the mill, three at each end. These fans will be driven by belts from individual electric motors.

After being thoroughly dried the board is conveyed to the next floor below



[illegible]

where it is calendered, packed and weighed, and is either shipped directly to market or stored on the same floor ready for transportation when desired.

As above stated, the entire equipment of shafting is located in the basement. This consists principally of a heavy main line supported by post hangers secured to the row of columns in center of mill. From this line the beating engines are directly belted, also the main water service pump, the elevator, the calenders on the floor next above, counter shafts for wet machines, agitators, and other miscellaneous machinery.

Floor Finish

Throughout the building all floors are of reinforced concrete, the basement floor being made of a concrete proportioned 1:2½:5, while the other floors are of a 1:2 mixture with trap rock, and on top of this is a 1-in. granolithic finish. The basement floor is a 6-in. concrete slab increasing to 8" at one side. The finished stock room floor is a 5½-in. slab and the dryer floor 4½".

Concrete Beater Tubs

Unique and distinguishing features of this plant are the beating engine tubs and wet machine vats which are constructed entirely of reinforced concrete, and it is thought that this is the first instance of the kind in this country. Much credit is due S. F. Dawson, treas. of the Milton Leatherboard Co. for originating the idea, and also for his courage in opposition to adverse criticism in carrying it into execution. The results have thus far been most gratifying, as so smooth and symmetrical are the tubs in appearance that they may be classed almost as works of art.

The method of construction of the tubs, in brief, was as follows:

First, the ledge was carefully leveled and cleaned at location of beaters. The reinforcement steel was bent to the desired shapes, assembled as a complete network and strongly wired together. This was then set up in final position. Neat wooden forms were constructed conforming to both inside and outside dimensions of the tub, carefully adjusted and secured to correct position, and the whole tub was then cast as one piece. Small bolts were embedded in the top at regular intervals for securing ordinary cast iron capping as commonly used for wooden tubs.

The backfall and midfeather were cast separately after the tub forms were removed, the reinforcing bars for these

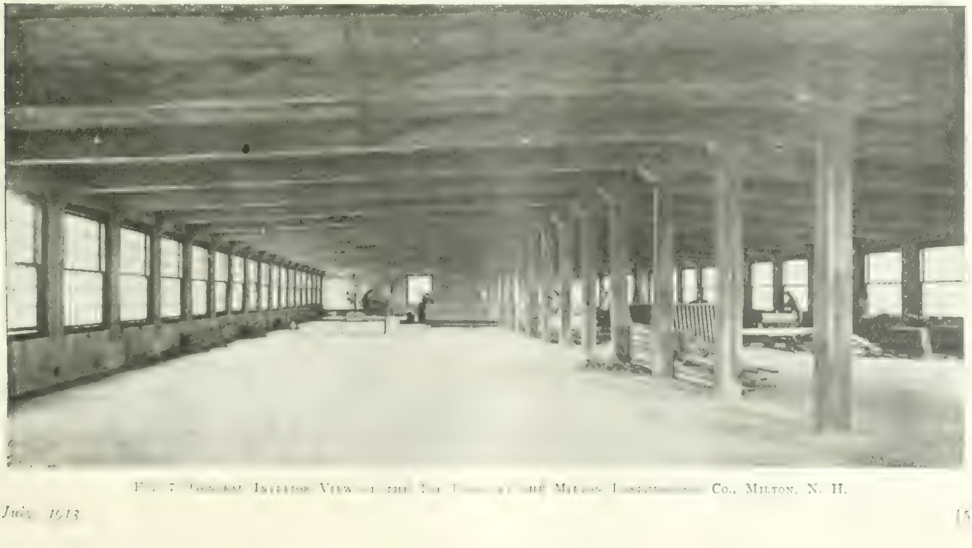


FIG. 7—GENERAL INTERIOR VIEW OF THE TOP FLOOR OF THE MILTON LEATHERBOARD CO., MILTON, N. H.

parts having previously been anchored into the tub bottom.

Special cast iron packing boxes were constructed, for the beater shaft, in such manner as to obtain the strongest possible connection with sides of the tub.

Brass emptying valves were set into bottom of tubs, connecting with underfloor conduits leading to stock chests, washout drains, etc.

After the forms were removed from the tubs, the basement floor was cast around them. This floor was laid on ledge foundation throughout, except over the sub-basement, where beams and slab were employed.

As will be seen by the several illustrations, the mill is extremely well lighted by an abundance of large windows. Besides, all walls and overhead ceilings have been treated with a coating of white cold water paint, which lends to the rooms a particularly bright and cheerful aspect.

Dam Construction

Another interesting feature of the work done on this plant is the method of reconstructing the dam which was originally built in the following manner: A heavy dry stone wall was laid up across the ledge gorge, through which the river flows, with the downstream face slightly battered. From the upstream top corner of this wall a backfilling of small stones was deposited until its surface was at an angle of 45° with the horizontal top of main wall. Cap logs were laid on the top of this wall, and other, sided, sticks were embedded in the stone backfilling, as spiking timbers. The whole surface was then planked, the upstream cap log having beveled edge to receive spikes from plank on the slope as well as those from the horizontal planking. Wooden bents were set up at regular intervals, secured by rods into the cap logs, and were provided with grooves for flash boards, and a plank walk laid on these bents extended across the dam. This dam was leaky and unsatisfactory, mainly on account of the difficulty of making tight connection with ledge at the toe, at time of construction.

In reconstructing the dam, a cofferdam was built a short distance upstream and the river flow diverted into an old abandoned mill-race, which conveyed the water back into its natural channel some distance below the mill. The planking was removed from the old dam and the cap logs from top of the heavy dry wall, but the spiking sticks in the slope, being sound, were not disturbed. All rubbish was then removed from toe of dam, leaving the ledge bare and clean. Forms were placed and a concrete facing was cast over the entire slope, ranging in thickness from 18" at bottom to 12" at top. This facing was carried over the top of the heavy dry wall and there increased in thickness, forming a caping about 3 ft. thick. Into this capping at regular intervals steel rods were embedded. At these points forms were set up and concrete bents were cast, provided with slots for holding flash boards, and a slab was cast over all for a walk. A neat pipe railing was installed beside the walk to insure safety in operating the flash boards. After the work was completed the cofferdam was removed, the water was run through the water wheels and a substantial concrete wall was constructed across the temporary diverting channel. Waste-ways were provided in this wall, equipped with gates and up-to-date mechanism.

The results of this work were most satisfactory, the dam now being watertight.

General Notes

The contract for constructing the entire plant was awarded the Aberthaw Construction Co., Boston. The wet machines and all iron work for beating engines were built by the Noble & Wood Machine Co., Hoosick Falls, N. Y. The generator and other electrical apparatus were furnished by the Allis-Chalmers Co., through its Boston office. The elevator, of 5 tons capacity, was purchased from, and installed by the Otis Elevator Co., 34-35 India Street, Boston.

The railroad track scales and inside shipping scales were purchased from the Howe Scale Co., Rutland, Vt.

The plant was designed, all plans furnished, and construction supervised by I. W. Jones, Cons. Engr., Milton, N. H.

One-Course Pavement Put Down in Two Layers

Some interesting views on one- and two-course concrete paving are presented by Clarence E. Bayley, city engineer of Pomona, Cal., in a paper prepared for the last convention of the League of California Municipalities. The following is an excerpt from that paper:

Having had an experience of some years with the various forms of paving, from the high-priced but sterling old Nicholson patent wood pavement, running thence down the scale to cedar block upon a sand foundation, I have, from a process of elimination, concentrated my thought and effort towards the perfection and adoption of a form of Portland cement concrete of a thickness commensurate with the needs of traffic, surfaced with a mat of asphaltum oil and screenings of from ¼" to ⅜" in thickness, as being at once the cheapest and best pavement available—best, because of speed and economy in construction and early availability and because it tends to minimize, if not wholly eliminate, friction in traffic by reason of the firmness of the foundation, thereby enabling larger, heavier loads and, for the same reason, greater ease in pleasure vehicles, and, cheaper, because in California, generally, granite boulders or other form or character of rock are so conveniently at hand. Boulders are in the main a source of annoyance and expense in clearing, and on account of their very abundance, are for convenient size for crushing and generally short, inexpensive hauls, a desirable material for a mineral aggregate.

My proposition differs largely from the commonly accepted methods of construction, inasmuch as I propose to eliminate the sidewalk form of surfacing and concentrate all of the good in Portland cement in one thickness of as good as 1:2:4 mix, in a thickness of not less than 4 in., and advancing in depth of structure as the traffic of the given street demands. Specifications largely require a sub-structure of 1.3½:8^1, or with a top wearing surface of 1:2 or 1:3, which from the very nature of Portlands is against permanency, the crystallization or hardening process tending to pull apart the wearing surface from the sub-structure, the wearing surface condensing and contracting in a varying ratio on account of the excess quantities of cement contained therein over the minor quantity in the sub-structure; moreover, a 1:2 or 1:3 surface is harder and therefore more slippery for animal use and contributes to an excess of noise so objectionable. Simple as the fabrication of a concrete pavement would seem to be, there is yet a great danger that in inexperienced hands its maximum strength and value may not be produced. The quantity of water should be sufficient only to produce a good martar plasticity, should be used in not exceeding 10 min. after applying water, and the concrete should never be laid upon ground until the grade has first been made, rolled thoroughly and "then some," and amply moistened to prevent absorption of the water in the concrete so essential to its crystallization. Differing from other forms of pavements, cement concrete can be made to conform to the engineer's contemplated crown in the most exacting detail, unlike sections produced under a 5- or 10- ton roller as by means of a template the surface of a concrete roadway can be drawn to perfect lines. My experience in handling Portland causes me to favor laying any thickness of work in two courses. In laying two courses, understand me, the one is almost coincident with the other, as I follow the first in not exceeding 5 min., generally less, and, though no set has taken place or can take place in that time, there is yet an imperceptible concentration in the first section that conserves the values in the cement and causes the second course to remain "live" long enough to promote its handling and so drawing to a clean, sharp line for section. In thicker sections this method would not be necessarily required, as the larger body would retain the "puddle" sufficiently long to compass the same results. Manipulation of concrete, as before stated, should cease in a period of 10 min. after water has been added.

I am not particular about rock, and should use any rock available, all within reason as to hardness and toughness. It ought to be crushed and screened to 1-in. cube size, never larger, except in bottom course of heavy work, and its own screenings, if uniform and properly proportioned to a percentage necessary to fill all voids thoroughly and fully will make a more satisfactory con-

[illegible]

The Recently Completed Public Library Building at Melbourne. The Dome Is of Reinforced Concrete With a Diameter of 120'

crete than with the use of sand. It goes without saying that the rock used should be clean and free from soils or other accretions, as any foreign matter deteriorates and prevents the full development of the strength of Partlands.

A Large Concrete Dome in Australia

The accompanying illustration shows the dome for the reading room of the recently completed Public Library building, Melbourne, Australia. This dome covers an octagon-shaped building 20,750 sq. ft. in area. The dome itself is 120' in inside diameter. The principal structural features are 16 main ribs which are 48" x 24" at the spring line and 24" x 18" at the crown. In the central part of the dome the ribs pitch against an octagon ring which is 34' in diameter. The distance between the opposing inside faces of the tension band at the spring line is 124' 6".

This dome was built by Swanson Bros., contractors, Melbourne; Bates, Peebles & Smart, are the architects. The reinforcing steel throughout was furnished by the Trussed Concrete Steel Co., Ltd., London.

It is interesting to compare this dome with many of the large domes in the world. The dome of the Pantheon at Rome is 142' in diameter, and St. Peter's, Rome, 137'. The dome of the Church of St. Sophia, at Constantinople, has a span of 105', while St. Paul's, London, has a span of 102'. The top of the lantern of the Melbourne dome is 114' above the level of the reading room.

This recent structure stands as a monument to the wonders of successful concrete construction.

Modern Construction in Madagascar

The accompanying illustration which has been received from James G. Carter, the American consul at Tamatave, Madagascar, shows a residence, office building and warehouse recently constructed at Tamatave by the Havraise Peninsulaire Steamship Co.

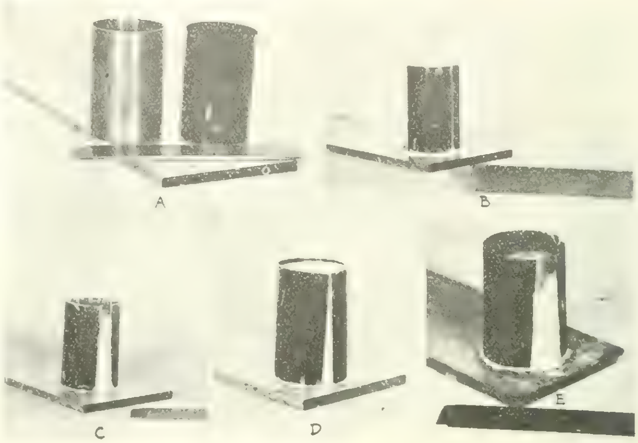
The construction shown in this building is adopted to meet best the condition and as shown in the illustrations, the residence uses both concrete and brick. The small office building is evidently of pre-cast concrete slabs, while the warehouse of steel frame will have concrete floor and foundation and concrete wall panels. The walls of the warehouses were under construction at the time the photograph was taken.

General View Showing Modern Construction in Madagascar
The residence, office and warehouse of the Havraise Peninsulaire Steamship Co. at Tamatave.

Apparatus for Determining Consistency*

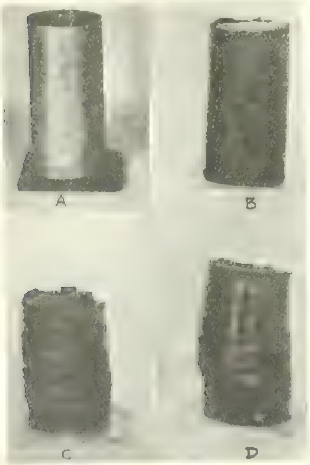
BY CLOYD M. CHAPMAN

The need of a method for the reasonably accurate determination of consistency of neat cement paste, lime paste, cement mortar, lime mortar and concrete has been felt for a long time. The Vicat needle has served its purpose in testing cement, and, with its only rival the "ball test," has furnished an accurate and simple means of determining the consistency of neat Portland cement paste. Neither the needle nor the ball method has been successfully applied to lime paste or to mortars and neither can be used at all with concrete. In fact, there is now no method in general use in this country for determining with any accuracy the consistency of a concrete, nor is there any way in use of describing a consistency except in broad descriptive terms such as "dry," "wet," "sloppy," "mushy," etc.



[illegible] FOR DETERMINING CONSISTENCY

In the case of cement-sand mortars using other than standard Ottawa sand, it has been customary to determine the consistency in a very roundabout way. First, the percentage of water required to make a paste of standard consistency with the particular cement used is determined by the Vicat needle or by the ball method. Then, by the aid of the table prepared by the Am. Soc. of Civ. Engrs., is determined the percentage of water which shall be used and a mortar is made up of a 1:3 mixture of cement and standard Ottawa sand of standard consistency. Then by making up a mixture of the sand and cement to be tested the operator may guess when he has the same consistency as the standard sand mortar. This is a crude and uncertain method of determining consistency of mortars and only one consistency can thus be determined, but it is the one in use at the present time. In the case of the lime pastes and lime mortars and of concrete there is no generally accepted method for determining consistency so far as the writer knows. As the necessity for testing all sand to be used in important concrete work is becoming more fully realized, there is an increasing demand and necessity for a method of determining the standard consistency to which mixtures of cement and the sand to be tested shall be mixed.



[illegible]

Consistency An Important Factor

Another demand for such a method arises from the increasing favor in which tests of concrete are held. Laboratory tests of concrete to determine the best proportions in which to use the available materials are becoming more common every year and a method is needed for standardizing consistency of the mixture so that results may be more nearly duplicated and conditions reproduced.

It is with a view to finding a simple and easy yet reasonably accurate method of determining consistency of rather wet concrete, in order that a series of tests might be carried out under uniform conditions by several college laboratories scattered over the country, that the first trials of the method here described were made in the laboratory of Westinghouse, Church, Kerr & Co., N. Y. C.

The method consists in depositing the mortar or concrete in a form of suitable size and shape resting on a nonabsorbent surface such as glass or metal and then removing the form and noting the settling or "sluffing" down, either with or without the assistance of a jar or shock, of the unsupported mass of paste, mortar or concrete left standing.

The size and shape of the form used depend upon the consistency to which it is desired to bring the material being tested, a low form of large area being used for soft, wet mixtures and smaller, taller forms for dryer mixtures.

For concrete containing coarser aggregate it is advisable to use a form at least twice the greatest dimension of the largest pieces. In case of stiff pastes or dry mortars or concrete it is necessary to jar or shock the mass in order to produce an appreciable settlement.

A very definite consistency for a wet concrete mixture may be determined as follows: A smooth circular metal form slightly tapering from end to end, about 3 in. in diameter at the larger end, 2⅞ in. at the smaller end, and open at both ends is placed on a glass plate with the larger end down, filled with the concrete to be tested and the top leveled off. The metal cylinder or form is then carefully lifted and the concrete allowed either to support itself, if dry enough to do so, or to settle down if wet enough to flow. The consistency desired is such that the concrete will just start to settle or "sluff off" when the form is lifted. If it stands erect and holds its shape without change, it is too dry. If it sinks to a heap it is too wet. If incipient settling or sinking takes place, the consistency is that sought.

In *A* of Fig. 1 is shown the only apparatus needed to perform the test; namely, a plate of glass or other nonabsorbent material and a slightly tapering cylinder about 3 in. in diameter and 5 in. high.

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* [illegible] 1913.

[illegible] & Co., N. Y. C.

In *B* is shown a test in which the concrete was too dry, and at *C* is one that was too wet, and at *D* one that was just right.

When the desired consistency is so stiff that no flow takes place when the form is removed, or if the material under test will not readily slip out of the form, then a membrane lining is used inside the form and jarring is resorted to in order to make the material under test settle or flow so as to permit measuring the amount of that flow.

The membrane used may be thin, hard rubber of such size as just to line the inside of the mold. This lining is placed inside the form before it is filled. After filling and removing the form the plate on which the test rests is lifted a definite height and allowed to fall. One of the methods by which this jarring may be accomplished is by inserting under one edge of the glass plate an object of the exact height that it is desired that the plate shall fall, and quickly withdrawing it.

The jar or shock causes the paste or mortar to settle somewhat and so increase its circumference. This increase in circumference is indicated by a gaping open of the ends of the membrane at the joint by a definite amount for a given consistency. If the gap is less than the proper amount, the mixture was too dry; if more, it was too wet.

In Fig 2 are shown at *A* the apparatus necessary for the test; namely the metal cylinder, glass plate, lining and metal strip for jarring.

At *B* is shown the specimen with the lining after the form has been removed and with a metal strip inserted under the edge of the glass plate ready to be withdrawn and allow the plate to drop.

At *C* is shown the specimen after the jar of falling and shows the opening of the lining due to the jar. At *D* is a similar test piece which was slightly too dry and, therefore, the opening of the lining was not equal to the required amount. At *E* is shown another, which was too wet and therefore opened too much.

Direct Reading Feature

As this opening of the lining is the indicator of the proper consistency, it is desirable that ready means be provided for measuring it. This may be accomplished by making the lining or a portion of it somewhat longer than the circumference of the form and allowing the ends to lap each other. One end of the lining is marked off in equal small divisions and the other end is arranged so as to make it convenient to read the amount of spreading near the bottom of the specimen. It is convenient also to measure the opening with a scale near the bottom. Under some conditions the lining opens somewhat as soon as the outer form is removed which makes it necessary to read the amount of this opening before jarring and deducting it from the final reading to get the amount of movement due to the jar.

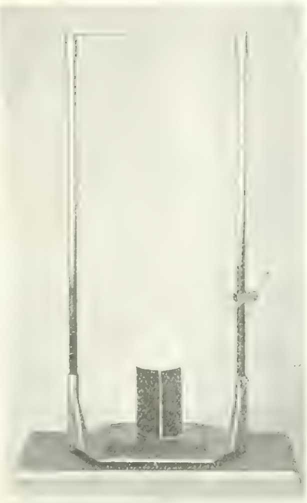

Fig. 3—An "Elevator" Used to Produce a Measured Drop in Testing Consistency

A number of materials have been tried in the search for a suitable lining for the molds. Oiled or waxed paper is satisfactory with lime putty, but not with cement. Thin sheet celluloid works well with lime putty and neat cement, but not with cement mortar. Thin, hard rubber seems to be the most satisfactory of the materials so far tried. It is smooth and flexible and is easily formed from the flat sheet into the desired cylindrical shape with the aid of moderate heat.

There are many details of the method which must be standardized for any particular consistency in any particular material or mixture. A normal neat cement paste placed in a 2-in. diameter mold 2½" high, when dropped ¾" on a 4" x 12" glass plate will increase its circumference or cause the lining to open about ⅛ in. A 1% excess of water will give an opening of greater amount, while 1% less water will produce an opening of less amount.

Producing a Measured Drop

There are many conditions under which it is not practical to use the very crude apparatus shown in Fig. 2-*A*, owing to the drop not being sufficient to jar the mass of material enough to produce the desired settling and consequent opening of the lining. A simple apparatus has therefore been devised by means of which the specimen may be dropped from any height up to 12". This apparatus is shown in Fig. 3 and consists of a platen, *A*, for receiving the specimen provided with vertical guides, *B*, so arranged that the platen may be raised to the predetermined height and held there by a catch, *C*, on one of the guides. Releasing the catch allows the platen carrying the specimen to fall and so produce the desired shock.

The diameter and height of the specimen are details of considerable importance. At the present time a diameter of about 2 in. and a height of 3 in. are being used for neat cement, lime putty, cement mortar and lime mortar. It may be found desirable to modify these dimensions somewhat after a wider experience has been gained in the use of the method.

Numerous tests of the method here described have been made on various materials and the results have indicated that with proper standardization it may be adapted to many of the uses for which there is at present a demand for a suitable method.

It has been used in the laboratory of Westinghouse, Church, Kerr & Co. for several months in testing Portland cement, lime, sand, mortars and concrete.

In the standard test for Portland cement it has been found that for a neat cement paste a spreading of the lining of about .25" under a drop of 3" corresponds very closely with a penetration of 10 m. m. of the Vicat needle. For the standard consistency of 1:3 mortar a drop of 2" produces an opening of about .25". With a medium stiff lime putty a 3-in. drop produces an opening of about .40" and a lime sand mortar of rather stiff consistency gives about the same result.

The limits beyond which the method is useless are well defined in both directions and lie between that consistency which is fluid enough to flow freely and that which is too stiff to alter its form under the influence of a comparatively light shock. The material under test must be plastic enough to conform itself to the container in which it is placed and to settle and expand in circumference under the influence of light jarrings, yet it must not be too fluid to have a tendency to maintain its form when at rest. Between these limits it is hoped the method will prove to be of some assistance in testing plastic materials, particularly concrete materials, and perhaps it may find some field of usefulness in the clay and other industries.

The plant of the Idaho Portland Cement Co., at Asotin, Wn., will be ready for operation by Dec. 1 next. The storage warehouse with a capacity of 60,000 bbls., the office building and the machine shops are all of reinforced concrete. It is intended to make this plant model in every respect. Raw material is to be brought from the company's lands at Lime Point, Idaho, in the company's barges. The Freeborn Eng. Co., Kansas City, Mo., has the contract for building the factory and the barges.

A reinforced concrete stack, 207' 6" high and 8' in diameter is to be erected at the plant of the Central Heating Co., Anderson, Ind. The General Concrete Construction Co., Columbus, O., has the contract.

Re-Rolled Steel Rail Reinforcing Bars*

A considerable proportion of the tonnage of reinforcing steel used annually is what is known as rail-carbon steel, that is, it is rolled from the heads and, at times, the webs and flanges, of railroad rails which have seen service and have been taken up. The following paper is a careful and comprehensive investigation in to the quality of this steel as a reinforcing material.

BY W. K. HATT†

The work was undertaken pursuant to general instructions embodied in a letter from C. F. W. Rys, under date of Aug. 6, 1912, as follows:

"Sub-Committee V, on Steel Reinforcing Bars, of Committee A-1 of the Am. Soc. for Testing Materials, desires to have you make an investigation to obtain data upon which to base a reasonable specification for re-rolled reinforcement bars, so-called; that is, bars re-rolled from rails or similar material.

"The investigation is to embrace the methods necessary to obtain representative samples for testing and the proper representative tests for material of this character. It should cover:

1. The quantity deemed proper for a lot for testing.
2. The effect of the size of the bar on the physical properties.
3. The effect of the design of the bar.
4. Variation in the properties of bars rolled from the head, web or flange of standard rails.
5. Variation in the properties of bars rolled from other material."

Limitations of Report.—This report covers reinforcing bars re-rolled from steel rails, and does not present facts with reference to other reinforcing bars rolled from billet steel or miscellaneous material. Several matters of technical and scientific interest, which are not necessary to the formation of a specification, are postponed—as, for instance, the true elastic limit versus the yield point of twisted and plain bars. Chemical analyses were not considered to be essential or helpful, and were omitted.

Process of Manufacture

Re-rolling Rails for Reinforcing Bars: The raw material used in the industry consists mainly of old rails which have been removed from service, although new rails known as seconds are used to some extent. These seconds are rails which have been rejected on account of some surface physical defects. Defects in a rail which might interfere with the rolling such as split heads, burrs or cracks, are carefully removed before the rail is permitted to enter the furnace. The old rails are, of course, mainly Bessemer. The kind of rails entering the furnace, and the samples collected and reported upon in this investigation are noted in the collectors' reports.

The rails used are usually broken into lengths of 10′ to 15′ before heating, although at least one mill is equipped to roll rails in their full length of 33′. The sizes and lengths of rails used depend in a great measure on the sizes of bars to be rolled. To roll bars of large cross-section and of considerable length requires a rail with a large head which is but slightly worn. When it is desired to roll a small bar from the web a shorter rail must be used, as otherwise the resulting bar would not only be inconvenient to handle, but too long for the hot beds.

The furnaces are equipped to hold from 45 rails to 65 rails, side by side in a horizontal position. The rails are fed to the furnace by a conveyor, and enter sidewise in some plants, and endwise in others. The rate of progress of the rail through the furnace is dependent on the speed of rolling. The distance from the coolest to the hottest portion of the furnace is such that the rail is heated slowly and uniformly. The average rate of rolling of ordinary bars is from ¾ min. to 1¼ min. each. Assuming a capacity of furnace of 60 rails, the time in the furnace would be from 45 min. to 75 min., as the case may be. The fuel used is coal, producer gas, or oil, and since all furnaces are equipped with forced draft the temperature is easily and uniformly regulated.

The rolling is very similar to that of any bar or small-shape mill, except in one particular. The head, web and flange must be rolled separately; consequently the first or first two passes must strip these elements from each other. The different parts are then rolled into the desired sizes and shapes, as in an ordinary mill. The size of mill, number of passes and reduction at the various passes is dependent upon the size and shape of the bar to be rolled. However, it is necessary that the larger sizes be rolled from the head and that the smaller sizes be rolled from the web or flange which has the smallest original section.

There is a discard from the end of the bar, and the portion of the bar representing the part of the web containing the bolt holes is sheared off either in the process of rolling or after the bar is rolled.

The changes in tensile strength and elongation consequent upon reduction of the rail in the rolls have been determined in this investigation.

The heat treatment in the furnace, the temperature of rolling and the temperature changes in the bar during twisting are all subject to well-known scientific laws, and need the same careful regulation as steel of like carbon content.

Although reinforcing steel is rolled from all three parts of the rail, most of it comes from the head. The web and flange furnish the small shapes such as flats, channels, angles and tees. These are furnished very extensively to the furniture and the agricultural implement industry. The latter industry also receives the major portion of harrow teeth and other small parts from plain bars of re-rolled rail steel.

Selection of Samples. At the outset of the investigation it was evident that a method of sampling must be planned so as to forestall the criticism that the samples might represent better material than the normal product of the mills. To this end the rolling schedules of several mills were determined a week or two in advance, and the collection made at unexpected times. These schedules were necessary so that it might be certain that the mills would be rolling reinforcing bars, and not some other product.

In the opinion of the writer and his collectors the rails fed to the furnaces were not specially selected and could not be.

The samples resulted from the re-rolling of rails of various size manufacture. The lighter sections were originally rolled about 1885 on the average; while the larger sections were of later rolling, about 1900 or thereafter.

The endeavor was to take such samples, spaced at equal intervals, that the results of tests would represent normal working conditions. Five out of the six mills concerned were sampled at variout periods from Sept., 1912, to Dec., 1912, and all kinds and sizes of bars from the various parts of the rail were represented in the samples.

Of course, the results are based upon a wide range of working conditions with respect to temperature of the air, design and size of bar, chemical composition, and size of the rails entering the mills. It is felt that under these conditions the data of tests may be sufficiently extensive to allow the formation of a specification, which shall be applicable to the normal product. The diagrams showing the effect of several factors, such as size of bar, design of bar, origin of bar, are of course expressions of tendencies rather than exact relations.

In contrast to this method, the selection of samples from material delivered to buildings under construction would be

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[illegible] from the official report to Sub-Committee V, on Steel Reinforcing Bars, of Committee A-1. The complete report covers the facts of collection of tests and analysis thereof, resulting from 2,036 samples of reinforcing bars re-rolled from steel rails. Upon these samples 1,719 tension tests and 1,264 bend tests were [illegible] time from Sept., 1912, to Feb., 1913.

†Purdue Univ., Lafayette, Ind.

Table I—Bend Tests. Percentages of Bars Bending to Various Angles

Size of Bar.	Mill.	Angle in Degrees.																									Total Number of Bars.
		180	175	167	165	160	155	150	145	140	135	130	127	125	120	115	105	85	78	75	60	50	45	30	25	20	
7/8-in.	A	71.6	73.6		75.5				81.1		84.1					86.8	90.5	92.5		94.3		96.2		98.1	100.0		53
3/4 "	"	100.0																									27
1 "	"	60.7	64.3				67.8			71.4					75.0			78.6		85.7	89.3		96.4			100.0	[illegible]
1/2 "	B	100.0																									95
1 1/8 "	"	77.8											88.9						100.0								9
1/2 "	C	94.0									95.5						97.0	98.5		100.0							66
1/2 "	All	97.5									98.1						98.8	99.4		100.0							161
5/8 "	C	94.5	96.4			98.2												100.0									55
7/8 "	"	71.4							100.0																		7
7/8 "	All	71.6	73.4		75.0				83.3		86.7					88.3	91.7	93.3		95.0		96.7		98.3	100.0		60
3/4 "	C	100.0																									19
3/4 "	All	100.0																									46
1 "	C	81.0			85.7											90.5		95.2		100.0							21
1 "	All	69.4	71.4		73.4		76.5			77.6					79.6	81.6		85.7		91.8	93.9		98.0			100.0	49
1 1/8 "	C	100.0																									7
1 1/8 "	All	87.5											93.8						100.0								16
1 1/4 "	C	76.5		82.4		88.2		94.1						100.0													17

Size and Kind of Bar.	Mill.	Angle in Degrees.							Total Number of Bars.
		180	175	160	110	105	80	55	
9/16-in. Pl. Rd.	C	100.0							20
5/8 " "	"	100.0							20
7/8 " "	"	100.0							10
3/4 " "	"	100.0							20
" "	"	90.0		95.0			100.0		20
5/8-in. Pl. Sq.	D	97.0	97.7		98.5	99.2		100.0	132
3/8-in. Pl. Rd.	E	100.0							62

Deformed Bars.

Size and Kind of Bar.	Mill.	Angle in Degrees.										Total Number of Bars.
		180	130	120	115	85	80	60	55	50	40	
9/16-in Co. Rd.	B	98.6	99.3		100.0							138
5/8 " "	B	97.9		100.0								48
7/8-in. Co. Sq.	E	86.2				88.0	91.4	94.9	96.5	98.3	100.0	58
7/8 " "	E	98.2			100.0							57

more or less haphazard. Records of mill tests made by other persons have been consulted to determine the relation of the usual commercial inspection tests to the tests made for this report.

The plan of sampling was briefly as follows: The collector stood at the shears at the end of the hot beds, and took a piece 3′ long off the fore end of 10 consecutive bars representing 10 consecutive part-rails (not a 30-ft. rail, but the portion of the rail that was put in the furnace). Forty part-rails were allowed to pass without sampling, and then 10 others were sampled in like manner. This process was repeated for a period of from one to two days for each mill. In some instances samples were collected that would have been rejected by the inspector before they would have been loaded on the cars. These are noted on the diagrams. The number of tension-test bars per ton of output varied from 2.6 to 8.

In addition to this normal sampling of old rails, a special investigation was made to determine the changes in the mechanical quality of the steel during [illegible]

Table II—Comparison of Positions in Rail

Old Rails.

Size and Kind of Bar.	Mill.	Position in Rail.	Tensile Strength.		Elongation.	
			lb. per sq. in.	Ratio.	Per cent.	Ratio.
9/16-in. Cor. Rd.	B	Head....	101 650	100.0	16.3	100
9/16 " "	"	Flange...	100 810	95.5	16.2	100
7/8-in. Cor. Sq.	E	Head...	99 190	100.0	17.9	100
5/8 " "	"	Flange...	95 660	96.0	17.3	98
3/8-in. Pl. Rd.	"	Web.....	106 470	101.0	15.2	90
3/4 " -1 1/8-in. Sq. Tw. ...	C	Head....	93 480	100.0	18.1	100
5/8 " Sq. Tw.	"	Flange...	90 000	96.0	18.8	102
1/2 " "	"	Web....	95 780	101.0	15.8	83
7/8 ", 1-in. Pl. Rd.	"	Head....	100 830	100.0	20.0	100
5/8 ", 3/4 " "	"	Flange...	99 810	99.0	18.2	91
9/16 " Pl. Rd.	"	Web.....	108 570	107.0	15.8	79

New Rails.

Size and Kind of Bar.	Mill.	Position in Rail.	lb. per sq. in.	Ratio.	Per cent.	Ratio.
7/8-in. Pl. Rd.	B	Head...	92 680	100.0	20.2	100
3/8 " "	"	Web....	96 590	102.0	18.8	93.0

American Society for Testing Materials

Nearly 400 Attend Sixteenth Annual Meeting held at Atlantic City, N. J.

The American Society for Testing Materials held its largest convention at the Traymore Hotel, Atlantic City, June 24-28. Coming after the successful and largely attended Congress of the International Association held in N. Y. C. last September as fully reported in the columns of CONCRETE-CEMENT AGE, the American Society struck another high mark in the convention just held at Atlantic City. The attendance ran close on to 400 and represented engineering talent of the highest calibre together with distinguished representatives of the large chemical and testing laboratories of the country and prominent manufacturers interested in the various papers discussed.

Opening Session

The first session was held on Tuesday, June 24, at 11 A. M. when the annual report of the Executive committee was presented. This report was one of the most satisfactory ever presented to the Society inasmuch as it showed the highest membership ever attained and the largest bank balance known in the annals of the Society.

Beginning with reference to the International Association Congress and the two large volumes of 1,100 pages each of the proceedings which are to be published in German, French and English, the Executive committee congratulates the Society upon the success of the Congress and thanks the various members for their zealous co-operation. It also publishes the letter of thanks of Dr. Belelubsky, the new President of the International Association, to the American Society for Testing Materials for its assistance in preparing for the Congress and for its furtherance of the aims of the Congress in every possible manner. In connection with the Congress, the Executive committee refers to the fact that one-sixth of the subscriptions of $42,000 received for the Congress was returned to the subscribers, a thing rare in the history of similar Congresses.

Increase in Membership

A diagram showing the increase of membership from the beginning of the Society after its organization in 1902 shows an increase from 175 members in that year to 1,574 members at the present convention and a continuous progressive gain. Reference is made to the policy of pre-printing reports and papers and their distribution to the membership far in advance of their presentation. This feature rendered the meeting most satisfactory and brought out debate of the most intelligent character.

It was stated that owing to a great improvement in the financial condition of the Society it has been possible to carry out the pre-printing of the papers in advance of its convention. A satisfactory thing to the members of the Society should be the fact that the proceeds from the sale of publications, which is the test of the esteem in which the Society is held in outer circles, increased from $982 to $2,524 within the period covered by the report.

Annual Elections

Reports were received from various committees and the election of officers was held, resulting in the selection of Prof. A. N. Talbot, of the Univ. of Illinois, as president, and Dr. Robert Moldenke as sec. vice-pres., and in the election of Wm. H. Bixby, John Brunner, F. H. Clark and Albert Sauveur as members of the Executive committee.

Proposed changes in the method of electing officers were discussed and Dr. Marburg moved that the whole matter be referred to the Executive committee for consideration.

Preservative Coatings

The second session, which was held Tuesday, June 24, was devoted to the reports and to papers on preservative coatings. A large interest was taken by paint experts and paint manufacturers as well as engineers who were present in the papers presented at this session.

President's Annual Address

The third session on the evening of Tuesday, June 24, was opened by the annual address of the Pres., Robert W. Hunt. A significant paragraph from Pres. Hunt's address follows:

> In the not distant past there was a more or less general feeling among the manufacturers of this country that specifications covering their products were entirely unnecessary. If it amused a customer to formulate such things and present them as describing that which they desired to purchase, well and good, but that the products should actually conform to the details of what they considered purely academic requirements, was a different proposition. They had been for years engaged in their several occupations and naturally knew more about them than was possible for any outsider. In a way, this was true, but the element of progression was involved, with the result that what had been equal to, and, therefore, satisfactory, under the requirements of yesterday became inadequate to the demands of today; and the situation could be best met by accurate observations of the behavior of materials of known composition under carefully observed conditions and measured stresses, and it is patent that without complete knowledge of observed materials, the obtained results would be so obscured that accurate deductions would be impossible.

The rest of the evening was devoted to the presentation of important papers on Heat Treatment of Steel by Albert Sauveur, J. H. Nead, N. W. Zimmerschied and J. H. Hall.

The fourth and fifth sessions held Wednesday morning and Wednesday evening were assigned to papers on steel and wrought iron, and much interesting information was presented by the various gentlemen whose papers were read and discussed.

Sessions on Cement and Concrete

The sixth session, Thursday, June 26, at 10 a. m., was devoted to papers on cement and concrete. This was one of the most largely attended meetings of the Society and papers of the highest standard were presented. The new president, Prof. Talbot, was in the chair and Dr. Marburg acted as secretary. The first business was the presentation of the report of Committee C-1 on Standard Specifications for Cement, George F. Swain, Chairm. This report gives an excellent summary of the good work being done toward securing uniform specifications by the co-operation of the committees of the Am. Soc. C. E., the Am. Soc. for Test. Mat. and the Government Department Committee on specifications for cement. This Joint Conference has had several meetings and has formulated plans for conducting various tests and other investigations, but so far the work has not progressed sufficiently to admit of conclusions and the committee has taken no action.

The next business was the presentation of Paper No. 32, "The report of Committee C-2 on Reinforced Concrete," Prof. F. E. Turneaure, Chairm. This report covered the activities of the committee for the past year and submitted a comprehensive report which will be published in the proceedings. Both of the reports were received and ordered filed and the committees continued in accordance with their requests.

The paper on the "Estimation of Fine Particles in Cement by Rate of Hydration," by Henry S. Spackman, was listened to with great attention. The paper on "The Action of Various Substances on Cement Mortars," by Richard K. Meade, gives a most valuable summary of all sorts of experiments as to the effect upon cement of various salts, oils and other materials. In brief form this paper gives much information that hitherto has taken the engineer considerable time to dig out, and gives experiments of great value upon the subject treated. This paper and the above paper by Mr. Spackman, will be covered in abstract in the August issue.

"A Method and Apparatus for Determining Consistency" was described by Cloyd M. Chapman, of the Westinghouse, Church, Kerr Co.'s laboratory. The paper is published in full on pp 8 and 9 of this issue.

Autoclave Discussion

The next paper was that entitled "The Results Obtained with the Autoclave for Cement," by H. J.. Force. This paper together with a summary of the discussion, is published in the July CEMENT MILL SECTION.

A Valuable Report on Waterproofing

The seventh session on the afternoon of Thursday, June 26, was devoted to cement, concrete and waterproofing. A very interesting paper was that of Committee D-8 on waterproofing material. The work of this Committee was found to be subdivided naturally into three branches:

1. The determination of causes of the permeability of concrete as usually made from mixtures of Portland cement, sand and stone, or other coarse aggregate.

2. The rendering of concrete more waterproof by adding to ordinary mixtures of cement, sand and stone, other substances which, either by their void-filling or repellent action, would tend to make the concrete less permeable;

3. The treatment of exposed surfaces after the concrete or mortar has been put in place and hardened more or less, either by penetrative, void-filling or repellent liquids, making the concrete itself less permeable or by extraneous protective coatings, preventing water having access to the concrete.

Considering these several sub-divisions separately and in the order named, the committee finds:

1. *Causes of Permeability of Concrete.*—That in the laboratory and under test conditions using properly graded and sized coarse and fine aggregates, in mixtures ranging from 1:2:4 to 1:3:6, impermeable concrete can invariably be produced. That even with sand of poor granulometric composition, with mixtures as rich as 1:2:4, permeable concrete is seldom, if ever, found and is a rare occurrence with mixtures of 1:3:6. But the fact remains, nevertheless, that the reverse obtains in actual construction, permeable concretes being encountered even with 1:2:4, mixtures and are of frequent occurrence where the quantity of the aggregate is increased. This is attributed to:

(*a*) Defective workmanship, resulting from improper proportioning, lack of thorough mixing, separation of the coarse aggregate from the fine aggregate and cement in transporting and placing the mixed concrete, lack of density through insufficient tamping or spading, and improper bonding of work joints, etc.;

(*b*) The use of imperfectly sized and graded aggregates;

(*c*) The use of excessive water, causing shrinkage cracks and formation of laitance seams;

(*d*) The lack of proper provision to take care of expansion and contraction, causing subsequent cracking.

Field Conditions Demand Waterproofing Precautions

Theoretically, none of these conditions should prevail on properly designed and supervised work, and are avoided in the laboratory and in the field, under test conditions, where speed of construction and cost are negligible items, instead of being governing features as they must be in actual construction. Properly graded sands and coarse aggregates are rarely, if ever, found in nature in sufficient quantities to be available for large construction, and the effect of poorly graded aggregates in producing permeable concrete is aggravated by poor and inefficient field work. Even if the contractor could afford the added expense of screening and re-mixing the aggregates so as to secure proper granulometric composition to give the density required to make untreated concretes impermeable, it is seemingly a commercial impossibility on large construction to obtain workmanship even approximating that found in laboratory work. It therefore seems that an impermeable concrete can be secured most economically by adopting some special waterproofing treatment.

2. *Addition of Foreign Substances to Cement or During Mixture.*—The committee finds that in consequence of the conditions outlined above, the use of substances calculated to make the concrete more impermeable—either incorporated in the cement or added to the concrete during mixing—has become general. This has resulted in the development and placing on the market of numerous patented or proprietary waterproofing compounds, the composition of which is more or less of a trade secret.

While it has been impossible for the committee to test all of the special waterproofing compounds being placed on the market, it has investigated a sufficient number of these, as well as the use of certain very finely-divided, naturally-occurring or readily-obtainable commercial mineral products, such as finely ground sand, colloidal clays, hydrated lime, etc., to form a general idea of the value of the different types. The committee finds:

(*a*) That the majority of patented and proprietary integral compounds tested have little or no permanent effect on the permeability of concrete and that some of these even have an injurious effect on the strength of mortar and concrete in which they are incorporated:

(b) That the permanent effect of such integral waterproofing additions, if dependent on the action of organic compounds, is very doubtful;

(*c*) That in view of their possible effect, not only upon the early strength, but also upon the durability of concrete after considerable periods, no integral waterproofing material should be used unless it has been subjected to long-time practical tests under proper observation to demonstrate its value, and unless its ingredients and the proportion in which they are present are known:

(*d*) That in general, more desirable results are obtainable from inert compounds acting mechanically, than from active chemical compounds whose efficiency depends on change of form through chemical action after addition to the concrete;

(*e*) That void-filling substances are more to be relied upon than those whose value depends on repellent action;

(*f*) That, assuming average quality in sizing of aggregates and reasonably good workmanship in mixing and placing the concretes, the addition of from 10% to 20% of very finely divided void-filling mineral substances may be expected to result in the production of concrete which under ordinary conditions of exposure will be found impermeable, provided the work joints are properly bonded, and cracks do not develop on drying or through change in volume due to atmospheric changes, or by settlement.

3. *External Treatments.*—While external treatment of concrete would not be necessary if the concrete itself, either naturally or by the addition of water-proofing material, were impermeable to water, it has been found in practice that in large construction, no matter how carefully the concrete itself has been made, cracks are apt to develop, due to shrinkage in drying out, expansion and contraction under changes of temperature, and moisture content and through settlement.

Protective Coatings Often Advisable

It is, therefore, often advisable on important construction to anticipate and provide for the possible occurrence of such cracks by external treatment with protective coatings. Such coating must be sufficiently elastic and cohesive to prevent the cracks extending through the coating itself. The application of merely penetrative void-filling liquid washes will not prevent the passage of water due to cracking of the concrete. The committee has, therefore, divided surface treatment into two heads:

(*a*) Penetrative void-filling liquid washes;

(*b*) Protective coatings, including all surface applications intended to prevent water coming in contact with the concrete.

While many penetrative washes are efficient in rendering concrete waterproof for limited periods, their efficiency is apt to decrease with time and it may be necessary to repeat such treatment. Some of these washes may be objectionable, due to discoloring the surface to which they are applied. The committee, therefore, believes that the first effort should be made to secure a concrete that is impermeable in itself and that penetrative void-filling washes should only be resorted to as a corrective measure.

Combination Waterproofing Recommended

While protective extraneous bituminous or asphaltic coatings are unnecessary, so far as the major portion of the concrete surface is concerned, provided the concrete—either in itself or through the addition of integral compounds—is made impermeable, they are valuable as a protection where cracks develop in a structure. It is therefore recommended that combination of the two methods—integral and extraneous waterproofing—be adopted in especially difficult or important work.

Considering the use of bituminous or asphaltic coatings, the committee finds:

(*a*) That such protective coatings are often subject to more or less deterioration with time, and may be attacked by injurious vapors or deleterious substances in solution in the water coming in contact with them;

(*b*) That the most effective method for applying such protection is either the setting of a course of impervious brick dipped in bituminous material into a solid bed of bituminous material, or the application of a sufficient number of layers of satisfactory membranous material cemented together with hot bitumen;

(*c*) That their durability and efficiency are very largely dependent on the care with which they are applied.

Such care refers particularly to proper cleaning and preparation of the concrete to insure as dry a surface as possible before application of the protective covering, the lapping of all joints of the membranous layers, and their thorough coating with the protective material. The use of this method of protection is further desirable because proper bituminous coverings offer resistance to stray electrical currents, the possible attack from which is referred to later.

The Use of Richer Mixtures

It has been suggested that impermeable concretes could be assured by using mixtures considerably richer in cement. While such practice would probably result in an immediate impermeable concrete, it is believed by many that the advantage is only temporary, as richer concretes are more subject to check cracking and are less constant in volume under changes of conditions of temperature, moisture, etc. Therefore, the use of more cement in mass concrete would cause increased cracking, unless some means of controlling the expansion and contraction be discovered. With reinforced concretes the objection is not so great, as the tendency to cracking is more or less counteracted by the reinforcement.

It has also been suggested that the presence in the cement of a larger percentage of very fine flour might result in the production of a denser and more impermeable concrete, through the formation of a larger amount of colloidal gels.

Neither of these suggestions has been especially investigated by the committee. Both appeal to the committee, however, for the reason that they substitute active cementitious substances for the largely inactive void-filling materials previously recommended, thus increasing the strength of the concrete.

In conclusion, the committee would point out that no addition of waterproofing compounds or substances can be relied upon to counteract completely the effect of bad workmanship, and that the production of impermeable concrete can only be hoped for where there is determined insistence on good workmanship.

The production of impermeable concrete has assumed greater importance since the appointment of this committee, owing to the well-known injurious action of saline or alkaline waters and to the suggested possible effect of the moisture in concrete occasioning or aggravating electrical action from stray currents.

Possible Electrolysis

Originally, the question of waterproofing involved mainly the physical troubles resulting from water passing through concrete without any special consideration of its effect on its durability, other than a gradual leaching out of the cement. Recent developments suggest the possibility that owing to the increased conductivity of damp concrete to electrical currents, such currents, if present, may so affect damp concrete as seriously to lessen its integrity, and this possibility further emphasizes the importance of the recommendation that no waterproofing compound of unknown chemical composition be added to concrete, as recent tests seem to show that the action of electrical currents is aggravated by the presence of certain solutions.

The report was signed by W. A. Aiken and Cyril De Wyrall, chairm. and sec. respectively of the committee.

Great interest was also taken in the paper on "Coal Tar and Asphalt Products for Waterproofing" by Samuel Tobias Wagner.

Papers Nos. 40 on "Test of Natural Concrete Aggregates" by Russell S. Greenman and 41 on "Tests of Mortars made from Wisconsin Aggregates" by Prof. M. O. Withey were listened to with great interest as they presented figures of great value to those having to do with mortars and concrete. These papers will be covered in later issues.

The discussion of papers 40 and 41 embraced also a consideration of paper No. 45 on "Some Observations on the Testing of Sand" by W. B. Reinke.

A Sand Committee Proposed

This group of papers which were discussed together led to a proposal on the part of W. A. Aiken that a committee to deal with the matter of sand and to provide specifications for it should be appointed by the Executive committee. Dr. Marburg replied that at the recent meeting of the Executive committee the appointment of such a committee had been considered and that it had been authorized subject to the approval of the committees on Standard Specifications for Cement and on Concrete and Reinforced Concrete, with whose work it would also have to deal.

Sanford E. Thompson in discussing the papers gave considerable interesting results from his practice in the use of various sands, while Mr. Spackman spoke of sand results in their laboratory as corroborative of the work done by the authors of the works presented.

A paper by A. T. Goldbeck on "Some Tests of Reinforced Concrete Slabs under Concentrated Loading" was replete with most interesting figures bearing upon the loading of slabs and led to a discussion which was participated in by W. A. Slater of the Univ. of Ill., Dr. Orton of Ohio State University, Prof. Hall of Purdue, and Sanford E. Thompson. The discussion of Messrs. Slater and Orton was accompanied by a number of diagrams, demonstrating the results obtained at the Universities in question.

Paper 43 on "Test Data on an Experimental Concrete Bridge" by A. N. Johnson was not available in printed form and was therefore passed. The discussion following paper 44, "The Thermal Activities of Portland Cement during the Period of Section" brought up much discussion. This is covered more in detail in the July Cement Mill Section of this paper.

Road Materials

Ceramics and Road Materials were the subjects of the eighth session held Friday, June 27, when the following papers were presented and discussed:—

46. Report of Committee [illegible]: On Standard Specifications for Brick. A. V. Bleininger, Chairman.
47. Report of Committee C-4: On Standard Specifications and Tests for Clay and Cement Sewer Pipes. Rudolph Hering, Chairman.
48. Report of Committee C-6: On Standard Tests and Specifications for Drain Tile. A. Marston, Chairman.
49. Report of Committee C-7: On Standard Specifications for Lime. Henry S. Spackman, Chairman.
50. Report of Committee D-4: On Standard Tests for Road Materials. Logan Waller Page, Chairman.
51. The Testing of Refractories. A. V. Bleininger.
52. The Relation between the Tests for the Wearing Qualities of Road-Building Rocks. Logan Waller Page.

The evening of Friday, June 27, was devoted to non-ferrous metals, while the proceedings Saturday when the tenth and last session was held consisted of the presentation of reports from committees having to do with standard methods of testing, on hardness tests, large capacity testing machines in this country and Europe and other miscellaneous business.

Social Features of the Convention

While the business side of the convention was naturally the most active and while the Am. Soc. for Test. Mat. is generally noted for the prompt and full attendance of its members at all its sessions it could not be considered that the Atlantic City convention was one of business only. An able committee on entertainment under the chairmanship of Anderson Polk was charged with providing amusements for members and their ladies during the convention, and automobile rides for the ladies and golf contests on the greens of the Country Club for the men were features of the entertainment Wednesday. The smoker Thursday night was no less successful, being attended by representatives from all parts of the country. The seductive fumes of a bowl of Philadelphia fish-house punch—compounded by One who Knows mingled with the fumes of the tobacco from corn-cob pipes furnished by the Entertainment committee, and old friendships were renewed and new friendships made under the mellifluous effects of the combined fumes. This feature of the Society's work, or rather pleasure, was a most commendable one and every year should tend more and more to bind the members together in a bond of social as well as scientific brotherhood.

A Failure In Frame Construction

No stronger argument for the use of concrete for amusement structures could be produced than the recent tragedy at Long Beach, Cal., where 36 lives were lost as the result of the collapse of a frame building. Almost 200 persons were seriously injured as well, when the floor of the Auditorium caved in under the undue stress laid upon insufficient and rotten timbers, too weak for the weight of 6,000 people, who were celebrating Empire Day, May 24. The fall of the upper floor, where the crowd was massed, bore down the lower floor, precipitating the mass of struggling humanity upon the sands beneath.

The probe of the disaster by building experts resulted in the condemnation of the huge building, which has been the scene of many conventions. It was found that the timbers were affected by dry rot, and that the corrosive effects of the sea-fog had rusted and weakened the nails. The building will be torn down and the present demand is for a reinforced concrete pier such as the municipal pleasure pier in Santa Monica.[1]

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[1] An all-concrete structure, built in 1908. The design and construction features of this pier were described in detail in *Concrete Engineering*, May 1908.

The Measurement of Actual Stresses

BY ARTHUR R. LORD*

This paper, by so convincing an authority as Mr. Lord, treats of present progress and future possibilities in determining actual stresses in reinforced concrete buildings.

All practicing engineers engaged in designing buildings and structures in reinforced concrete or structural steel are fully aware that an element of uncertainty pervades even the most accurate calculation of stress in a composite structure. Granted our *assumptions,* it is relatively simple to compute the stresses. But no actual problem in design ever resolves itself into definite and absolute conditions such as we find in the college text-book, and so engineers have been forced to deal with assumed quantities and thereby they are bound to keep well on the safe side and to follow but slowly on the heels of experience. Most of our routine problems are so familiar and seem so firmly established by practice that we often entirely forget that there is any assumption involved in them. It is only when we come to the perpetual puzzles, like the problem of earth pressure, and to the newly arrived problems such as multiple-way reinforcement, that we realize that a gap of greater or less width always does exist between theoretical and applied mechanics. In many cases this gap is so narrow that practically everybody steps across without giving it a thought; in other cases some venture lightly across with apparently no concern, some of us build a bridge that seems to us adequate in every way—and some are still waiting to be shown conclusively.

The function of the testing engineer is to bridge the gap between theory and practice—to discover the facts on which to build up the final mathematical structure. He may do this in either of two ways. He may study the real problem and seek to analyze it into its component parts and then reproduce these singly or in small groups in laboratory specimens. By controlling the number and the combination of the variables he may discover the fundamental relations which exist between them and so formulate rules for design which, taken in their proper environment, are safe. Most present-day designing is based on the sanction at least of such laboratory tests, even in the cases where the formula preceded the test, and in reinforced concrete the formulas are more often accepted because of the supporting test data. But laboratory specimens are very rarely full-size and almost never do they reproduce with exactness the conditions which we have to meet in actual designing. While they minimize the effect of assumptions in design, and while to them is largely due the present orderly and standardized computation of many types of reinforced concrete members, it must be realized that much laboratory information has to be (and is) stretched beyond the elastic limit in applications which are currently made.

To meet this situation the testing engineer has devised instruments and methods to tie together theory and design by measuring the stresses which occur in the completed buildings under their actual load conditions. This second method of the testing engineer has many obvious and universally recognized advantages—it appeals to one as the natural supplement of the laboratory test and it raises the hope that many problems thus far unsolved may yet be reduced to a reasonable domesticity. One of the best known concrete engineers, on reading the report of the first measurement of stresses in a reinforced concrete building only two years ago, remarked: "It's impossible!"—today he is preparing to have tests for actual stresses made for his own commercial use.

At the present time the field testing of buildings for actual stresses is sufficiently advanced so that we may safely call it an established and permanent science. The accuracy of measurement thus far achieved is not so great as that obtained in laboratory work, but even in the first test of a reinforced concrete building the stress measurements were well within the range of refinement possible in present-day design and with each succeeding test the precision has been increased by finer instruments and improved testing methods founded on experience. The test of the Larkin warehouse in Chicago in 1912 gave more data, more valuable data, and answered more questions than did the Deere & Webber test of 1910,—and did this at a lower cost. Recent tests establish the fact clearly that the data are not only of great value for the purpose of general design with constructions for which there is not a generally accepted mathematical theory, but that they are also sufficiently precise to justify refined calculations on points of more purely scientific interest. And the rapid rise of the field test for actual stresses has fostered the development of direct contact extensometers of great flexibility which have in turn made the laboratory more efficient. The field test does not in any sense supercede the laboratory test, but it has doubled the possibility of service for the testing engineer.

It is outside the province of this paper to describe in detail the methods of a test for actual stresses. Prof. W. A. Slater, of the Univ. of Ill. Engrg. Exp. Stat. has done that most admirably.[1] While the actual work of testing involves experience with delicate instruments which most engineers lack, all of us may plan the outlines of such tests and study the detailed data with much interest and profit. I know of no better way to get at the fundamental considerations of design than to try to plan a test which shall furnish the data desired for design. And in this connection it seems to me that the impression which sometimes finds expression today and which considers that the sole function of the test for actual stresses is to illumine problems of great mathematical complexity, is mistaken. While this branch of testing has naturally started with the less well-understood and newer forms of building construction, tests of standardized beam-and-girder designs show that our knowledge of such constructions is not nearly so complete as it may easily be. All monolithic concrete buildings introduce to the designer new and complex problems which his text-books never even attempt to solve. Results of tests for actual stresses already published have thrown light on a number of moot questions and indicate the possibilities of the method. I am not here considering especially steel construction, tile arches, and many similar standard forms of construction in which tests for actual stresses are as much needed as in reinforced concrete construction.

The writer believes that building tests for actual stresses have passed the probational stage. Up to the present time the responsibility has rested largely on a few individuals, with the financial backing of one or two far-sighted, progressive commercial firms. On the testing side its center has been at the Engrg. Exp. Stat. of the Univ. of Ill. The facts have been made public, however, largely through the N. A. C. U., and it seems to the writer that with the Association lies the opportunity of creating a central organizing and directing body which may act to provide financial support, and to correlate and give out the data secured. The possibilities of this line of testing are so great (as I shall try to indicate later) that only an efficiently organized and influential national body can hope to direct them adequately.

The future will undoubtedly see the rapid extension of the field for building tests for actual stresses. Our present city requirements for load tests are in general illogical and inconclusive. In Chicago, for instance, the test requirement is a superimposed load equal the sum of the weight of the construction, plus twice the design live load. And the basis of acceptance is that the deflection shall not exceed 1/800 of the span, regardless of the type of construction, the depth of members, or the length of the span. Instead of christening the structure with a live load of 2½ times that for which it was designed, would it not be more reasonable and more conclusive to measure the actual stresses under a small over-load placed in the manner most severely taxing the construction? The reduction in the load material to be handled would pay for the services of the testing observer who takes the readings and computes the stresses from the observed deformations.

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*Struct. and Test. Eng., Chicago

[1] Paper read before the Kansas City convention of the N. A. C. U., Mar., 1912

Our present tests have been confined almost without exception to a single loading and unloading of a previously unstressed construction. Would a second loading give the same results? The magnitude of the loads applied in several of the tests already made establishes clearly that the data obtained are amply safe for use in general design, but the value of a test under repetitive loading is no less on that account. A central body may easily assume the necessary financial burden to build the apparatus required to use some load that can be easily placed and removed, such as water, and by making a number of tests reduce the cost of each to a very low figure.

A central body may easily undertake the study of the effect of the details of construction and of construction methods on the strength. What is the relation of stresses in wall panels to those in interior panels? How are stresses distributed in rectangular panels? What is the effect of openings on the stress in adjacent construction? What effect has the size of the supporting column? What is the effect of varying the amount of reinforcement and its distribution? On all of these problems we have made a very creditable beginning toward securing data for design purposes, but the future must take them up methodically and completely, and the laboratory will contribute its share by testing specially designed specimens, not incomparable in size and capacity to the actual structures, in which we may deal with few variables at a time. Such tests are already planned for the present year.

The life-size laboratory specimen is required also to answer satisfactorily one deficiency of the building test for actual stresses. You cannot destroy your building in order to get information by which to design your next one better. We must rely on test of large specimens to destruction for final information as to the weakest point in the design and for final information on shearing strength. Our present tests demonstrate the safety of our buildings, but we must test to destruction before we can make balanced designs, of equal strength in all respects, and so arrive at economy. This is a most important new field for research. In some respects we are undoubtedly supplying too much strength to our present structures—in others barely enough to stand the pressure. By detailed measurements of stresses we may hope to remove the tax which ignorance always collects from industry, and to arrive at a balanced design.

Present-day tests are short time tests. What is the effect of long continued loading and unloading? What is the effect of temperature? A continuous record of the changes of deformation which take place through the years would seem to be of value, even though its interpretation might be difficult. In all the recent tests made under the writer's supervision permanent inserts, or gauge points, have been placed and remain in the structure and it is the intention of the writer to secure from time to time under the actual load conditions in the buildings measurements of the changes in deformation and to compare these with the test observations. The experiment is limited by the available time and by the expense, and has not as yet progressed sufficiently to make it desirable to report results. Similar measurements on faces of walls exposed to the weather might give valuable information on the question of temperature reinforcement.

I have jotted down these notes on the present status of building tests for actual stresses and on the possibilities which seem to me easy of accomplishment in the near future at the request of Concrete-Cement Age in the hope that a central directing body may be made possible through the aid and desire of the engineers interested in the future of reinforced concrete who read these pages from month to month. What the engineers of America really desire they will soon obtain.

Petition in bankruptcy against the Chanute Cement Co., Chanute, Kans., which was recently filed, has been dismissed by the court on the ground that the claim on which suit was brought was so small as to make the petition unjust. The plant, which has a daily capacity of 1,000 bbls., will probably resume operations in the immediate future.

Tests of Reinforced Concrete Buildings Under Load

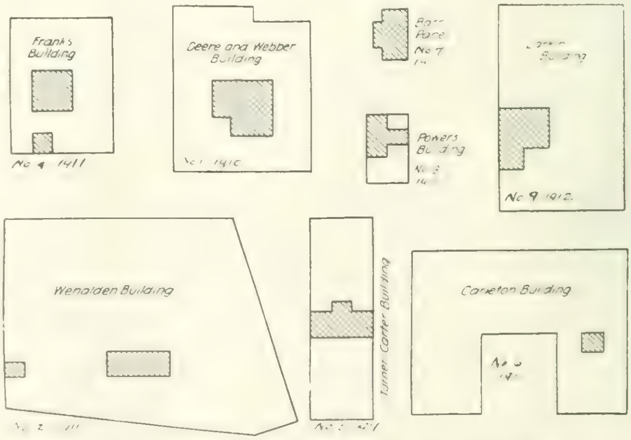
In this issue, an article by Arthur R. Lord sums up the progress so far made in analytical tests conducted on actual building structures, and points out the future possibilities of such tests, and their relation to laboratory investigation and design theory. Of interest in this connection is a recent bulletin issued by the Engineering Experiment Station of the Univ. of Ill. entitled, "Tests of Reinforced Concrete Buildings under Load,"[1] which summarizes the results of the tests so far carried out. These tests have been reported in detail in past issues of *Concrete* and *Cement Age*, but it is of interest to list in abstract the tests of buildings so far made. This the bulletin referred to does, in the opening pages, as follows:

Test No. 1. Deere and Webber Bldg., Minneapolis, Minn., Oct. and Nov., 1910. Flat slab floor with four-way reinforcement, built by Leonard Construction Co., Chicago, and tested by co-operation between the contractors and the Engineering Experiment Station of the Univ. of Ill.

Test No. 2. Wenalden Bldg., Chicago. June and July, 1911. Beam and girder building constructed by Ferro-Concrete Construction Co., Cincinnati, and tests made by co-operation among the N. A. C. U., the construction company, and the Engineering Experiment Station of the Univ. of Ill.

Test No. 3. The Powers Bldg., Minneapolis, Minn., July and August, 1911. Flat slab floor with two-way reinforcement, built and tested by Corrugated Bar Co., St. Louis.

Test No. 4. Franks Bldg., Chicago, Aug., 1911. Flat slab floor with four-way reinforcement, built and tested by Leonard Construction Co., Chicago. Prof. W. K. Hatt, of Purdue Univ., was



[illegible]

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[1] [illegible] bot and Willis A. Slater, Engineering Experiment Station, Univ. of Illinois, Urbana, Ill., [illegible]

employed as consulting engineer for this test.

Test No. 5. Turner-Carter Bldg., Brooklyn, N. Y., Sept., 1911. Beam and girder floor, built by Turner Construction Co., N. Y. C.; test made by cooperation among N. A. C. U., the construction company, and the Engineering Experiment Station of the Univ. of Ill.

Test No. 6. Carleton Bldg., St. Louis, Oct., 1911. Flat slab floor with two-way reinforcement, built and tested by Corrugated Bar Co., Buffalo.

Test No. 7. Barr Bldg., St. Louis, Dec., 1911. Full size test panel (25′ x 26′ 9″); terra-cotta tile used to lighten construction; consists of two-way T-beams with web between tile on tension side and concrete flange above the tile on the compression side. Panel built by the Corrugated Bar Co. to demonstrate efficiency of design proposed for Barr Bldg. in St. Louis; test made by Corrugated Bar Co.

Test No. 8. Ford Motor Car Co. Bldg., Detroit, Feb. and Mar., 1912. Flat slab floor, built and tested by the Corrugated Bar Co.

Test No. 9. Larkin Bldg., Chicago, August, 1912. Flat slab floor, built and tested by Leonard Construction Co.

The Deere and Webber Bldg. test was undertaken to learn the general action of the flat floor slab. The tests on the Wenalden Bldg. and the Turner-Carter Bldg. were made to find the general action of the beam and girder type of construction. The tests made by the Corrugated Bar Co. were for its own information but the results of the tests on the Powers Bldg. and on the Barr Bldg. test panel were presented before the 8th Annual Convention of the N. A. C. U. Those of the Carleton Bldg. and the Ford Motor Car Co. Bldg. were in the nature of investigation of special features of design. The Franks Bldg. test made by the Leonard Construction Co. was an investigation to obtain a basis for making provision in the Chicago building code for this form of construction. The Larkin test was the most extensive of those enumerated and was made with the object of furnishing the Leonard Construction Co. with additional information for the design of flat slab floors.

In conclusion the bulletin referred to states that the tests described are of value in helping to settle a number of questions which have been in dispute. When taken in connection with other tests, the results may be expected to be of considerable assistance in developing analyses and determining constants for use in the design of reinforced concrete structures. Many of the results of the tests have a bearing upon the unsettled problems and even on matters which many have considered to be not open to question.

These tests have shown the practicability of measuring the deformations or strains in critical parts or members of a reinforced concrete structure when subjected to load. Methods have been developed for making measurements and tests in a way that will give trust- [illegible] found necessary have been formulated. Skill and experience are essential in making such tests, and the difficulties encountered are of a wider range than [illegible] tice. As in other tests, caution must be exercised in drawing conclusions, and [illegible] results. The presence of low stresses should not be taken as being conclusively indicative of low bending moments; and the action of tension in the concrete, of horizontal thrust distributed over large distances, and of other agencies may need consideration. Action under partial load, as when a single panel is loaded, must be recognized to differ from that under full load.

Such problems as the distribution of bending moments along the length of the beam, the distribution of stresses over areas outside of those usually assumed as forming the beam, the presence of secondary stresses and of web stresses in structures as they are fabricated, will be solved only when adequate field tests have been made. The analysis of structures and the determination of the resistance of individual members or parts require thr making of assumptions and the choice of constants, and the proper determination of these may be made only with full knowledge of the properties of the materials found by laboratory tests and of the action of the fabricated structure as shown in adequate field tests.

Small Concrete Dwellings in Egypt

The Egyptian Delta Light and Ry. Co., Ltd., was confronted with the problem of erecting quarters for certain of its subordinate station officials (native Egyptians) at a cost which would enable a rent to be charged commensurate with the necessarily small salary drawn by those officials, and yet provide a reasonable rate of interest on the capital outlay. Reinforced concrete afforded the only practicable solution, after extensive trials. A recent issue of *Concrete and Constructural Engineering* (London) describes this work as follows:

The unit used is one room and an enclosed courtyard for menials, with two rooms and a courtyard for assistant station masters, and three rooms and a courtyard for station masters. Each room has an area of 3 m. by 3 m. (9.84′ x 9.84′), a height in front of 3 m. (9.84′) and at the rear 2.50 m. (8.08′). The single couryard is 2.50 m. (8.08′) broad by 3 m. (9.84′) long, and the double courtyard 2.50 m. (8.08′) broad by 6.20 m. (20.34′) long, all inside measurements.

The walls are built of concrete, the method of construction being as follows: Timber molds were first of all made according to drawings at a cost of £15 ($73). These are then placed on the ground at the site of the building horizontally, so arranged as to come into position when raised vertically. The insides are coated with oil and the reinforcing element—consisting of discarded semaphore wire—is laid in such a manner as to form a network, the ends extending some 2 ft. outside. The window and the door for each unit are then put in place. The concrete mixture consists of:

½-in. diameter Abou Zaabal gravel; 3½ parts.
Fine sand, 1½ parts.
Gillingham Portland cement, 1 part.

It is poured into the mold and subsequently kept moist by means of wet sacks, being left to set for seven days. The sides of the molds are removed and the slabs, now set, are raised on end into position by means of a winch and shear-legs. The edges are joined by passing a ¾-in. dia. iron rod vertically and looping the projecting ends of the reinforcing wire round it, subsequently giving the whole a covering coat of cement.

The whole of the structure has a clean face and requires no touching up whatsoever. The roof is of ordinary galvanized iron.

The cost of constructing the single unit, one room and courtyard, in the manner described is £12 ($58.39), the double unit like the one described costs £25 ($121.66), and the treble unit £40 ($194.64). The annual rent is fixed at 10% of this, and is gladly paid by the staff, as no equally substantial habitation and one so easily kept clean, can be obtained locally for double the sum, and the amount is well within the means of even the lowest paid employee.

Two-Way Reinforced Concrete and Tile Floor

BY CHAS. V. WEIN*

The past few years have witnessed many developments in two-way reinforced concrete and tile floors. The following notes describe a system which has been used extensively in Canada and abroad for many years. To American designers and builders, the use of a flat slab for a single span 39′ 4″ x 78′ 9″ will be of interest.

There are numerous fireproof floor constructions on the market. Some of them are really fireproof, while numerous systems cannot stand a hard test. Most of the first type are designed for use in "sky-scraper" steel structures, i. e., they are short span floors. A few of them, however, are also adaptable for long spans and some even in connection with reinforced concrete girders and columns. As the annual loss of property by fire is extremely high in this country, we ought to build even medium sized and small dwellings, residences, schools, office buildings, factories, etc., as fireproof as possible. A low-cost but high class system of fireproof floor construction is very desirable.

The following paragraphs describe a system of floor construction which is known as the "Faber Fire-resisting Floor," and, while not so well known in the U. S., yet it has been used extensively in Canada and Europe.

Construction

The floor, as shown in Fig. 1, forms a solid slab spanning the entire area. The design is based on scientific principles to give the greatest possible carrying capacity and smallest possible dead weight.

The principal component parts of the construction are fireproof hollow tile blocks and a reinforcement of steel bars placed between the blocks and embedded in concrete. The hollow tiles, which are usually of the size 10″ x 10″ x 6″ or of other square shape, are made of approved clay, or of other fireproof material, and are of uniform high quality and great supporting power. These blocks are grooved for receiving the reinforcing rods and for keying the concrete.

The method of laying the floor is as follows: Wooden or other centering is fixed in the usual manner at the required levels as indicated in Fig. 1, and on this the hollow tile blocks are placed in rows, spaces being left between them for the tension rods and concrete. Tubes are inserted between the hollows of the blocks, and these prevent the concrete from running in and filling the hollows, thus preventing waste and additional weight to the floor. The reinforcing bars which run in both directions are supported temporarily at the required heights until the concrete is run in and thoroughly tamped around the bars. The centering can be removed within a short time and the ceiling is then ready for plastering.

The reinforcing bars running in one direction form a complete net with those running in the other direction, so that the tension is overcome in both directions, and the load is transmitted to the four supports formed by the walls. For great spans or for extra heavy loads, the floor is strengthened by an additional layer of concrete, the thickness of which depends upon the special case to be dealt with. Statical calculations of the floor

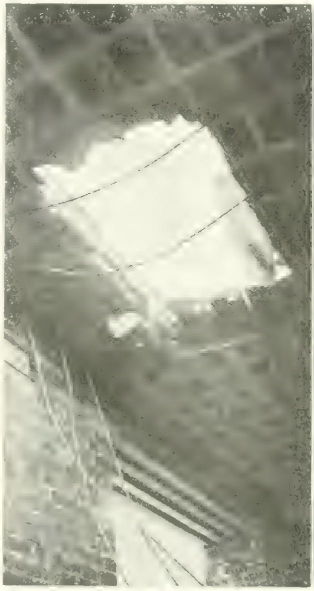

FIG. 2—AN ACCIDENT IN THE CONSTRUCTION OF A CONCRETE FLOOR

The building is situated at Gotha, Germany, and was built in [illegible]. The view shows the damage done by a 2,000-lb. stone falling with sufficient force to crush through the floor

[illegible]

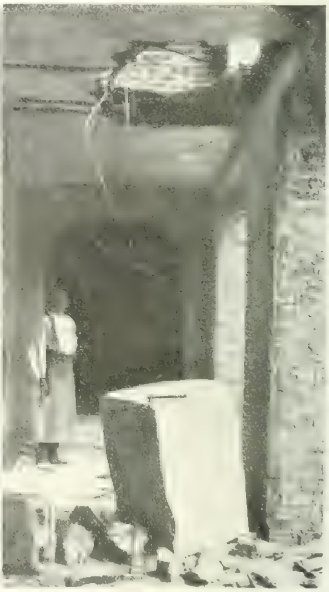

FIG. 3—A MORE GENERAL VIEW OF THE MANNER IN WHICH A CONCRETE FLOOR STOOD UP UNDER IMPACT BLOW

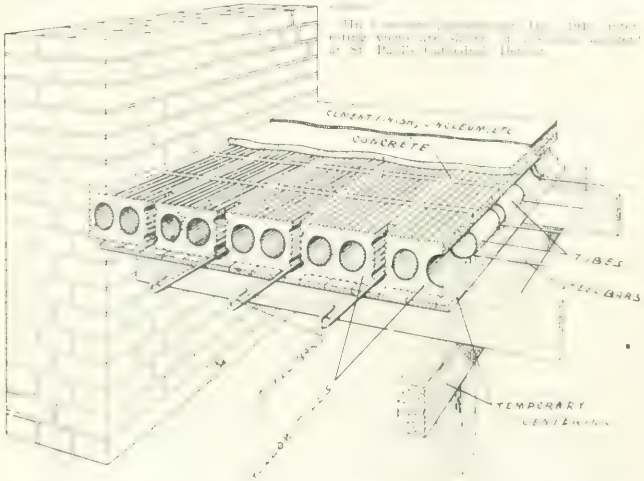

FIG. 1—[illegible] THE ARRANGEMENT OF [illegible]

are made in compliance with the building ordinances of each city or locality.

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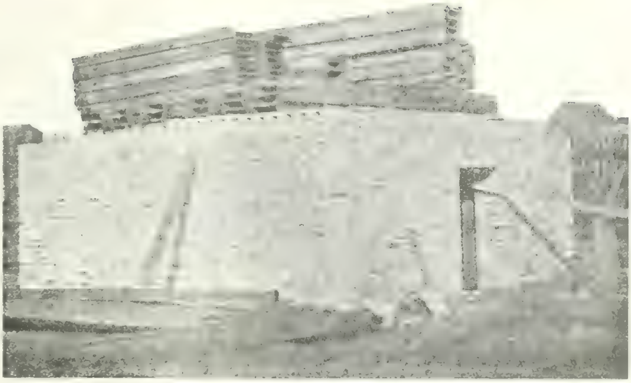
*[illegible]

Fire Resistance

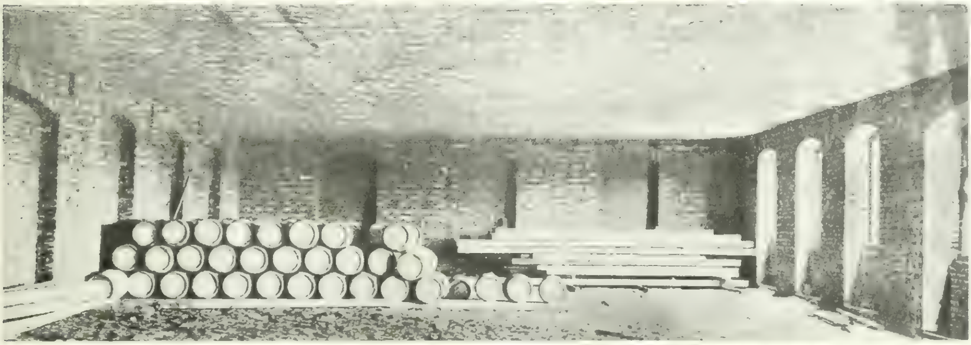
The "Faber" system is an approved form of fire resisting construction, girders not being required even in case of large spans up to 36′. Imperfectly protected steel beams have been proved a great danger in fires, for by expansion and twisting they may cause the collapse of the whole structure, as has repeatedly happened. In this system, on the other hand, the reinforcing bars used, being of a relatively very small sectional area and completely encased on all sides by the concrete, cannot form an element of danger.

Sound Deadening Capacity

A disadvantage of nearly all floors constructed of wood or concrete is the ready manner in which sound is transmitted. This disadvantage is, to a certain



[illegible] Steel



[illegible] Reinforced Concrete Construction in a [illegible] Flat Slab [illegible]

[illegible]

extent, overcome by the combination tile and concrete floor system, on account of the continuous hollow spaces and the small sectional area of the reinforcing bars.

Another advantage that is gained by the use of hollow blocks of such a system for floors and roofs is that air conductor, thus keeping the floors warm, ceiling beneath is prevented, which in while condensation of moisture on the tained in those spaces acts as a non-conmany cases, as will be admitted, is of great advantage.

As to the sound-deadening capacity of the floor a number of tests have been made. One of the most interesting official tests was the equipment of school children with wooden shoes, and having them pass over floors at school time. The result was simply astonishing. The noise was scarcely noticeable. The children marched some time, yet there was no sound except a slight dull noise to be heard.

Openings in Floors

Openings can be cut or left in such floors with perfect ease and safety, without the stability of the floors being impaired in any way. Windows and door openings can be covered over at the same time as the floors are laid, without lintels being required.

Figs. 2 and 3 are illustrations of a floor upon which cut stone of about 2,000 lbs. weight fell from a considerable height. The stone could not do any important harm to the floor except it cut a relatively small hole through it.

Carrying Capacity

The "Faber" floor can be constructed to carry a distributed or concentrated load on spans up to 36′ and even more.

In Fig. 4 is shown a test floor at Milwaukee in which a span of 14′ 9″ x 14′ 9″ was loaded up to 35 tons. At a test in N. Y. C., a slab of 20′ x 25′ had a concentrated load at the center of 25,000 lbs., the load being on 15 days; the deflection was only 3/16″. After the load was removed the deflection disappeared entirely.

The old Laval University, Quebec, was rebuilt, using "Faber" system floors. This structure was built a long time ago to last for centuries, but it was not at all fireproof. The modern demands made it necessary to throw out everything from the inside of the building, to replace the old wooden colums and beams by steel construction and to put in fireproof floors and fireproof partitions. With the "Faber" floor a saving of about 40% over steel construction was made possible by the long spans the use of the system allows. About 71,000 sq. ft. of floor were made fireproof. E. Tanguay, of Quebec, was the architect. This work, which was done by the Canadian Fireproofing Co., was designed and erected under the superintendence of the author.

Fig. 6 shows the Technical School of Quebec recently erected by the Quebec Provincial Government, and provided with 26,700 sq. ft. of long span "Faber" floors. René P. Lemay, of Quebec, was the architect. Other buildings built with this system of floor construction are the *Daily Telegraph* building, and the Caisse d'Economie, both at Quebec, besides many other buildings, such as schools, dwellings, public buildings, factories, stables, etc. It is of interest to note that this system of flooring is used in the Kaiserin Auguste Victoria Hospital on the Oil Mountain near Jerusalem, Palestine, and the new Residential Palace of the Emperor of Germany, at Posen.

In New York, the "Faber" floor has been used in an office building at No. 19 W. 20th St., and in a bank building at No. 87 William St. In Bound Brook, N. J., the film factory of Pathé Frères, and in Delawanna, N. J., the oil cloth factory of J. R. Goodlatte Sons are provided with "Faber" floors.

Notes on Old Roman Construction and Materials

In a recent R. I. B. A.[1] examination, one of the questions on Greek and Roman architecture was as follows:

> Describe travertine, peperino, tufa, and pozzolana. How were they used by the Romans? Given some typical examples of their use, and explain and illustrate the various methods adopted by the Romans of facing concrete walls with brick and stone.

A recent issue of the *Architects' and Builders' Journal* published a model answer to this question as follows:

Travertine, tufa, peperino, and pozzolana were the most important materials used for general constructional purposes by the Romans.

Travertine, a hard limestone, is nearly pure carbonate of lime, quarried near Tivoli, and is employed as a facing to the concrete walls of the Colosseum.

Tufa, a stone of volcanic origin, of which the hills of Rome are mainly composed, was employed in early Roman buildings to a great extent, but its bad weathering qualities were a defect, and for this reason it was usually faced with stucco.

Peperino is a stone of volcanic origin from Mount Albano. It is harder than the hardest variety of tufa, is a fairly good weathering stone, and is fireproof.

Pozzolana is a volcanic deposit existing in large quantities under and all round Rome in thick strata, just as it was showered out of the neighboring volcanoes. It resembles a sandy earth mixed with larger lumps about the size of coarse gravel. When mixed with lime, it forms a strong hydraulic cement. This material contributed largely to the durability of Roman architecture.

The faced concrete walls were of four varieties:—

(*a*) Concrete faced with "opus incertum," the concrete backing being studded with irregular-shaped pieces of stone. This was used in the first and second centuries B. C.

(*b*) Concrete faced with "opus recticulatum," resembling the meshes of a net, the joints being laid in diagonal lines.

(*c*) Concrete faced with brick (testæ), used from the first century B. C. to the end of the Western Empire. Walls were faced with bricks triangular in plan, and 1½″ thick.

(*d*) Concrete with "opus mixtum," being a wall of concrete faced with brick and having stone bands at intervals. (See sketches.)

The Effect of Acids and Oils On Concrete.

Current consultation questions have discussed the effect of acid, alkalies and mineral and vegetable oils on concrete. An interesting review of the entire matter is presented in the report of investigations made by W. L. Gadd, an English engineer. These tests indicate that mineral acids dissolve the constituents of Portland cement to a great extent even when exceedingly dilute. Organic acids act less destructively on concrete but there is still a reaction between the weak acid and the calcium hydroxide which is present in the concrete.

The use of concrete for floors in soap factories has a direct relation to actual oils and fats on concrete surfaces. This English engineer finds that animal and vegetable oils have a direct action on green concrete, and may eventually destroy it, due to the saponification of the glycerides by the calcium hydroxide. This action of course is less destructive when the concrete is older.

While saponification is not involved when mineral oils are used, these oils weaken mortar to some extent and the resulting concrete is less waterproof. The series of tests referred to did not indicate the value of concrete waterproofing with oil and in the author's opinion better and more waterproof concrete is produced with a carefully graded aggregate than with the addition of oil.

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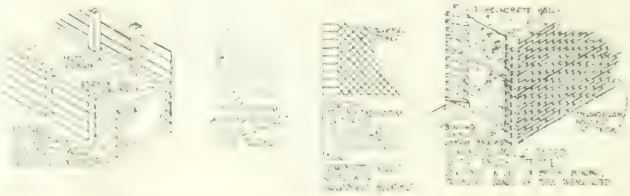
[1] [illegible]



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Concrete Tile and Joist Construction

A preliminary test of a new type of reinforced concrete floor, known as "concrete tile" construction, was made in Spokane April 28 at the plant of the Spokane Concrete Co., in the presence of a number of architects, engineers and contractors.

In the design of reinforced concrete slabs for long spans it is desirable, for the sake of economy, to reduce as far as possible the dead weight of the construction. This result is frequently obtained by the use of a combination of hollow terra cotta tile and concrete, in which case the tile acts as a filler and provides a certain amount of void space in the slab. This serves to reduce the weight of the construction but does not contribute to its strength. In this construction, which has been very commonly used in localities where the tile can be readily obtained, it is necessary to pour concrete in the joists formed between the rows of tile and also on top of the tile, usually to a depth of at least 2" in order to provide the necessary compression flange. A typical cross-section of this type of construction is shown in Fig. 1.

The concrete tile construction on which the test was made in Spokane consists of rows of hollow concrete tile with joists poured between the rows but no concrete poured on top. The concrete tile are designed to act as an integral part of the structural floor, in the same manner as though the entire slab were poured monolithic. To secure this action, the concrete tile (Fig. 3), are provided with alternate lugs and flutes on the sides and also with beveled edges at one end, so that when the concrete is poured between the rows of tile all parts of the construction are mechanically united.

The theory underlying the design is similar to that used in the design of a plate girder, the lugs on the sides of the tile performing the same function as rivets. The stresses in the lugs are those of bearing and shear (pure shear, not diagonal tension), and have their maximum values at the extreme fibres, namely at the top and the bottom of the slab, being zero at the neutral axis. The angle of bevel used on the edges of the lugs as also on the ends of the tile is kept less than the angle of sliding friction between concrete surfaces, or not to exceed 30°.

The advantages claimed for concrete tile construction by its inventors and patentees, E. and A. B. White, structural engineers of Spokane, are: A fire-proof and sound-proof construction of great economy and adaptability for long spans; ease and speed of erection; a smooth, neat appearing flat ceiling of uniform color, suitable either with or without plastering; and the promotion of local industry, as concrete tile can be manufactured in any locality where materials for concrete are available in the same manner as building block, pipe, etc.

In the manufacture of concrete tile, a dry mix can be used having the same proportions as the poured concrete, although a somewhat smaller aggregate will usually be found desirable. A thoroughly sound and strong concrete can be obtained with a 1:6 mixture, the aggregate consisting of about equal parts of fine and coarse sand and screened gravel up to ½-in. size. The materials should be mixed just damp enough to compact well under tamping (by machine or by hand), and should be stiff enough so that the collapsible form can be at once removed and used repeatedly.

The tile should be stored under cover on the original pallets and kept thoroughly drenched with water for at least one week, and preferably two weeks. Tile made in this manner will show as great strength at the age of two or three weeks as poured concrete will in three months, and can be readily handled without breakage. It will usually be found desirable to have the concrete tile manufactured in the same locality as the structure in which they are to be used to save expense of shipping.

Details of the test slab used at Spokane are shown in Figs. 4, 5, and 6. The concrete tile for this slab were manufactured April 3, 1913, and the

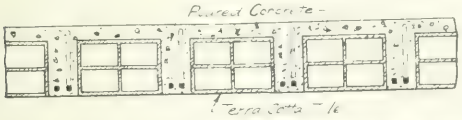


Fig. 1—Cross-Section Showing Typical Construction of Terra Cotta Tile and Reinforced Concrete T-Beams

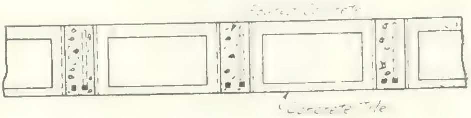


Fig. 2—Cross-Section Showing Concrete Tile and Reinforced Concrete Joist

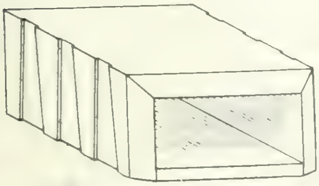
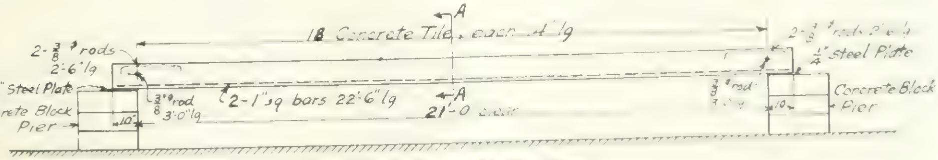


Fig. 3—Isometric View of Concrete Tile Showing Corrugations at the Side to Develop Mechanical Bond



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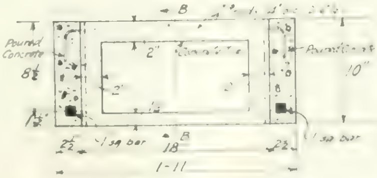

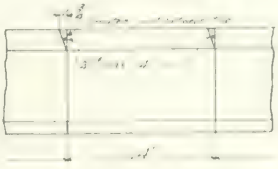

[illegible]

slab was poured April 5, 1913. The materials used for the concrete were cement[1] and aggregate as described above. The concrete tile were hand tamped, with a dry 1:7, mixture and the poured concrete consisted of a wet 1:6 mixture except the joints across the top for which a 1:2 mix was used.

The main reinforcing bars were square corrugated bars of high carbon steel, rolled from new billet stock. The slab was designed for 70 lbs. per sq. ft. live load plus 70 lbs. per sq. ft. dead load, with extreme fibre stress in concrete of 650 lbs. per sq. in. and corresponding stress in steel of 12,200 lbs. per sq. in., as determined by the straight-line formula with a ratio of moduli of elasticity of 15.

Forms were removed from under the slab, on the 18th day after pouring, causing a deflection at the middle of 0.11 inch, and on the 23rd day the slab was tested to destruction. The test load was applied in the form of bags of cement having an average weight of 95 lbs. each, which were placed in layers of 20 bags each. After each layer was placed, deflections were observed at the middle and the quarter points of the span on both sides of the slab by means of wires stretched between the projecting ends of rods embedded in the ends of the slab over the supports.

As care was taken in applying the load evenly, there was practically no difference in the deflections observed on the two sides of the slab. The deflection at the middle caused by a live load of 140 lbs. per sq. ft., or twice the designed live load, was 0.42" or 1/600 of the span. The deflections increased regularly as the load was applied, and the last observations were made under a live load of 423 lbs. per sq. ft., when the deflection at the middle was about 1½ in.

Up to this point no cracks in the slab or other indications of failure could be observed. Failure occurred suddenly under a live load of 470 lbs. per sq. ft. being a typical shear failure or diagonal break in the concrete near the end of the span, allowing the entire slab with its load to drop a short distance down to the floor upon which the supporting piers rested. The ultimate strength developed by the construction, especially considering the greenness of the concrete, was remarkable.

The concrete tile and poured concrete acted together in the manner designed, and the diagonal break which caused failure extended uniformly through the poured concrete and the sides of the tile. There was no indication of compression failure, and it is probable that the slab would have sustained an even greater load, had shear reinforcement been provided.

The deflections at the middle for the various loads, including dead load, are given below, also a list of computed deflections and stresses based on the straight-line formula, neglecting tension in the concrete, and with a ratio of moduli of elasticity of 15. The influence of the tensile strength of the concrete is seen in the fact of the observed deflections being less than the computed ones for the smaller loads. The "average shearing stress" tabulated is for the cross-section of web above the plane of the steel, including both the poured concrete and the sides of the tile (9" x 8½").

[illegible]

Total Load Lbs.	Deflection at Middle Ins.	Computed Deflection Ins.	Stresses—[illegible]		
			Computed Tension in Steel	Compression Extreme Fibre	Average Shearing Stress
[illegible]	0.11	0.22	[illegible]	[illegible]	[illegible]
[illegible]	0.23	[illegible]	10200	544	
6620	[illegible]	0.52	14300	[illegible]	43
[illegible]	0.53	0.66	18400	[illegible]	56
[illegible]	0.72	0.81	22500	1200	[illegible]
12320	0.91	[illegible]	[illegible]	[illegible]	[illegible]
14220	1.09	[illegible]	30700	[illegible]	93
16120	1.28	1.26	34800	1860	105
18020	[illegible]	1.40	[illegible]	2080	[illegible]
[illegible]	[illegible]	1.55	43000	2290	130
[illegible]	Shear Failure		[illegible]	[illegible]	143

Solving the Housing Problem in Paris

Nearly 10 years ago, La Société Anonyme de Logements Economiques pour Familles Nombreuses was founded in Paris, with the objects of providing low-cost, hygienic and comfortable dwellings and of demonstrating to capital that dwellings of this type can be made to pay a fair return on capital invested in them. It was originally capitalized at 236,000 frs., but it has since been raised to 2,000,000 frs.

Four buildings have already been erected and a fifth will be finished next year. The four buildings are located at different points of the city and the following table is of interest:

Location	Occupants Total	Occupants Children	Children per Suite
Menilmontant—Rue de Telegraphe	514	352	4.88
Montmartre—Rue Belliard	611	[illegible]	4.62
Vaugirard—Rue du Contentin	831	593	5.54
Gobelins Blvd. Kellermann	664	453	4.23

These four establishments contain 1,312 rooms divided into 380 lodgings, in suites running from two to four rooms.

They cost, including sites, 2,302,500 frs., and have a gross revenue of 146,530 frs., with a cost of management and upkeep of 32,528 frs., which shows net earnings of 114,002 frs., or very close to 5% on the cost.

La Société de Foyer has erected one building, housing about 250 people.

La Société Anonyme des Habitations à Bon Marché has also erected one building, which was completed at Auteuil in 1911. It houses about 250 people, of whom 153 are children.

Public and private enterprise and philanthropy have in a way united in the building of La Société des Logements Populaires Hygiéniques. The land occupied by its building in Montmartre belongs to the municipality and is leased for 75 yrs. at a nominal rental of 20 frs. per yr., with the provision that at the expiration of the lease the building shall become the property of the municipality. Public enterprise has also furnished 60% of the capital required for building, the loan being made at 3%, to be repaid in 50 yrs.

The building contains 60 suites which are uniformly rented at 250 frs. per yr. The building houses 360 people, of whom 240 are children. It earns a net revenue of 12,000 frs. on a construction cost of 260,000 frs.

Some Notes On Cost of Pavement Concrete

A piece of concrete pavement work for Milwaukee county was a road 18' wide and 7" thick. The work was done by 20 men, using a ½-yd. Chain Belt[1] mixer with chute delivery. The water was piped along the road from the city as in the preceding case, but a 4½-h.p. gasoline engine was necessary to force the water up to the head required. The work recorded covered a period of four days and cost $1,128.46, exclusive of equipment and grading. The cost of piping and water for this and the preceding job was fully accounted for in a former paragraph. The cost of the work was divided as follows: 414 bbls. of cement, $430.92; 92 yds. of sand and 152.3 yds. of gravel, $340.84; water, $60.20; Baker[2] protection plates for expansion joints, $76.50; coal and oil for mixer and engine, $7.50, and labor, $232.50. From these figures we arrive at a cost of $4.70 per cubic yard and $ .91 per sq. yd. for the pavement.

In southwestern Michigan a short strip 798' long, 9' wide and 7" thick, of 1:2:4 concrete, cost $717.83, exclusive of grading, equipment and water. The equipment consisted of a seven cubic foot Clover Leaf[3] Mixer, necessary wheelbarrows and shovels and lumber for forms. The gang on this road was much smaller than that on any of the other roads. Two hundred twenty-five barrels of cement cost $234, 69 yds. of sand cost $37.59, 136.35 yds. of gravel cost $196.34, gasoline and oil for mixer cost $10, Baker plates cost $96 and labor $144, making the cost per cu. yd. $4.68 and per sq. yd. $.91.—*C. W. Boynton, Universal Portland Cement Co., Chicago, in a recent paper.*

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[1] Inland [illegible] Co.'s cement was used.

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[1] Chain Belt Co., Milwaukee.
[2] R. D. Baker Co., Detroit.
[3] Clover Leaf Co., South Bend, Ind.

Reinforced Concrete Roof Tiles for Aqueduct Buildings

The Board of Water Supply of New York City, charged with the construction of the largest municipal waterworks in the world, has decided upon the adoption of reinforced concrete roof tiles after extensive experiments and numerous consultations with manufacturers to aid in determining the most generally satisfactory roof covering for buildings along the aqueduct. Terra cotta, granite, slate and reinforced concrete were among the materials investigated, and after careful comparison it was decided that reinforced concrete best satisfied the requirements of economy, appearance and durability. A tile roof of this material is exceptionally light and strong. These tiles are easily placed as they rest directly upon purlins, and in gate-houses or similar buildings, their undersides serve as ceilings. Several full-size tiles were made and tested at the Board of Water Supply's laboratory in New York.

As the roofs are of the hip type the tiles are of three main classes,—pan tiles, hip tiles and ridge tiles. The metal frame-work of the roof is completely encased in cement mortar for permanence. The pan tiles are laid directly on purlins equally spaced and are fitted with a lug to hook over these. The pan tiles average 54" by 23" exposed to the weather. Along one edge is cast a rib designed to lay the adjoining tile and form a weatherproof joint. Provision is made for packing this joint with elastic cement and a calking of jute or yarn.

The thickness of the pan tiles excepting at the ribs along the edges shall, according to the specifications, approximate 1⅛". No tile shall be less than 1" thick. The concrete mixture in general is specified as 1:2½ or 3. The specifications provide for either integral or surface coloring and the exposed surfaces of the tiles are required to have a cut stone or ribbed texture. Wire fabric and steel rods are preferred types of reinforcing, and these must be at least ¼" from the surface. One of the strict restrictions of the specification forbids a variation from any dimension of over ⅛".

The acceptance tests appear comprehensive, including a 7-days' test against leakage under a 3-in. depth of water and a strength test when 28 days old which requires a central load of 600 lbs. to be borne at the center of a span of 35".

In appearance these reinforced concrete tile roofs remind one of the stone roof slabs of the ancient Greek temples.

A Reinforced Concrete Gas Tank Holder in Spain

Northern Spain, more than any other section of the country, has appreciated the advantage of reinforced concrete. Numerous structures have been built of this material and their number increases daily.

Floors, bridges, waterworks, standpipes and other structures of varying type have been built and in every case the advantages of this material have been demonstrated. Some of the more recent ones are entitled to particular attention, owing to their importance.

One, in particular, is the gas-tank container, built for the gas company of San Sebastian, under the supervision of the engineer, Wenceslas Aguirrebengoa. This is the first structure of this kind ever built in Spain.

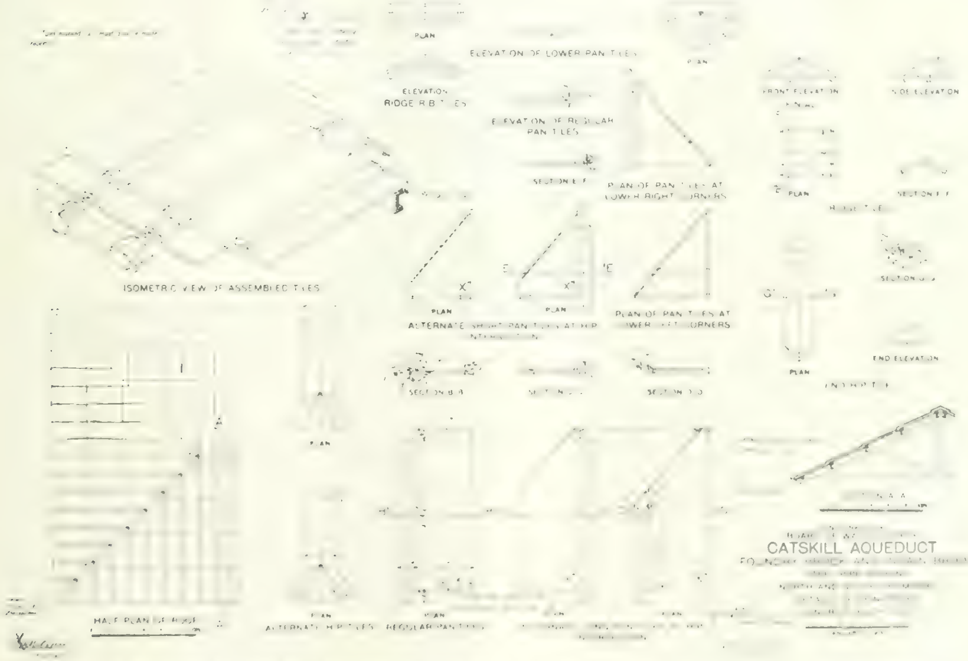
Owing to increased business, the company found it necessary to increase its plant and it was determined to construct a tank with a capacity of 6,000 cu. m. (7847.6566 cu. yds.) The Hennebique system of reinforcement was used.

The tank is 24.078 m. (78') in diameter and 7.8 m. (25') high.

It was feared at first that the soil at the site was unstable, but excavation disclosed bed-rock, which was amply strong for the load to be carried. When the excavation was completed a foundation layer of Zumaya hydraulic lime was deposited, making a level surface.

The bottom of the tank is only 10 cm. (4") thick, with walls 30 cm. (12") at the bottom and 10 cm. (4") at the top. The wall is cast monolithic with the bottom. It is divided into 10 sections by T-shaped columns, designed to carry the the columns of the metal superstructure.

Around the upper circumference of the tank is a gangway 1 m. (3.28') wide for the workmen in charge of the tank.


PLAN
ELEVATION OF LOWER PAN TILES
ELEVATION RIDGE RIB TILES
ELEVATION OF REGULAR PAN TILES
SECTION E-F
PLAN OF PAN TILES AT LOWER RIGHT CORNERS
FRONT ELEVATION
SIDE ELEVATION
PLAN
SECTION F-F
ISOMETRIC VIEW OF ASSEMBLED TILES
PLAN
PLAN
PLAN OF PAN TILES AT LOWER LEFT CORNERS
END ELEVATION
SECTION B-B
SECTION D-D
HALF PLAN OF ROOF
ALTERNATE HIP TILES
REGULAR PAN TILES
CATSKILL AQUEDUCT

[illegible]

[illegible] northwest of the Indian brook siphon

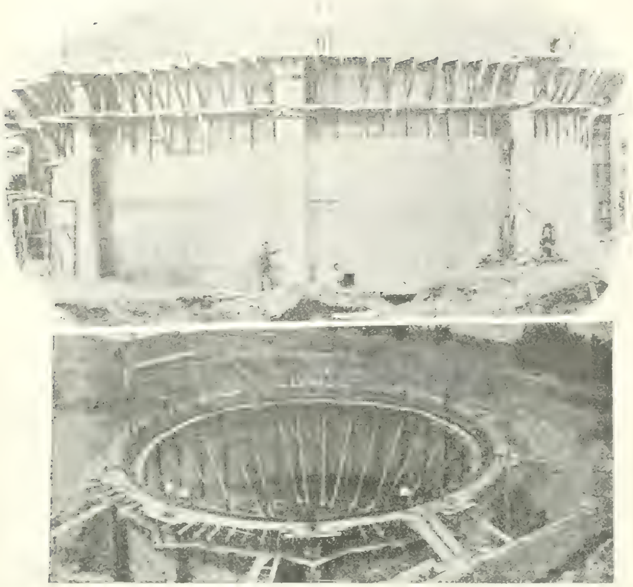


Fig. 1—The Upper View Shows the Forms Used on the Exterior of the Concrete Gas Tank Container

Below is shown, as [illegible] at about the same time

Two and one-half months were required to complete the concrete work. In order to make a waterproof structure, a rather rich mix was used.

After the application of a coat of waterproof mortar, 1:1 cement and sand, the tank was tested by filling it with water. Owing to the very limited water supply, this took eight days. When the water had reached a height of 4 m. (9.48′) damp spots began to appear on the outside and as the load increased water began to ooze to some extent, but no cracks developed anywhere. When the tank was completely filled, the following losses of water were noted:

Aug. 4 10 liters (10.566 qts.) in 28 sec.
Aug. 5 10 " " " " 40 sec.
Aug. 6 10 " " " " 50 sec.
Aug. 7 10 " " " " 80 sec.

Owing to a rain-storm, the tests were discontinued after Aug. 6, but it was noticeable that the oozing decreased steadily and the pores finally closed, presumably by the deposit of insoluble salts.

It required four months to install the metal superstructure. When it was finished the concrete tank was again filled with water. For the first 48 hrs. there was a very slight oozing, but since that time the tank has remained absolutely tight.

In its appearance the tank is surprisingly slender, in comparison with the ordinary stone tanks. The experience at San Sebastian has been that tanks of reinforced concrete are more rapidly built than those of stone and cost less.

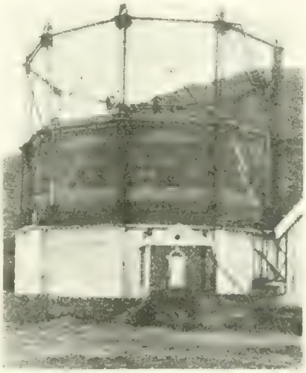


Fig. 2.—The Completed Gas Tank [illegible]

Building Inspectors in Los Angeles

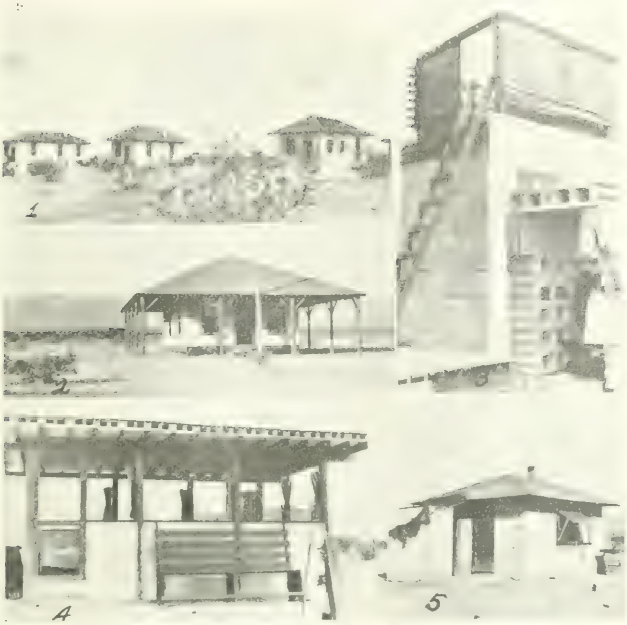
Effective June 7, Sections 175 and 176 of the Los Angeles building code are amended so as to require an inspector on all reinforced concrete work while the concrete is being placed. This inspector is to be employed by the owner, architect, engineer or builder, but must be satisfactory to the Bd. of Public Works. The materials used, especially the cement, will have to be up to more rigid test requirements. Following are Secs. 175 and 176 in full as adopted.

Sec. 175. (Amendment effective June 7, 1913, in full as follows:) Before a permit is granted to construct or erect any reinforced concrete building or structure, the applicant for such permit shall file with the Bd. of Pub. Wks. complete drawings, specifications and details, and schedules of all loads for all columns, beams, joists and girders, showing the size and position of all reinforced members. Such plans and specifications shall exhibit the approval and signature of a licensed architect or a structural engineer. An inspector who shall be under the direction of and satisfactory to the Bd. of Pub. Wks., shall be employed by the owner, architect, engineer, contractor or other person, firm or corporation constructing or erecting any such reinforced concrete building or structure, to see that the work of constructing or erecting any such reinforced concrete building or structure conforms to the requirements of this ordinance. Every such inspector shall be present at all times while the actual work of mixing and depositing any such concrete, used or intended to be used in the construction or erection of any such reinforced concrete building or structure, is in progress.

Sec. 176. Tests of Cement. Only Portland cement shall be permitted in reinforced or non-reinforced concrete construction.

All cement for reinforced concrete construction, for fireproofing, for the floor construction and for finish, shall be tested as herein provided. One complete test shall be made for each 200 bbls. or fraction thereof. All cement for non-reinforced concrete, including walls and column footings, where the required total under the building permit exceeds 100 bbls., shall be tested as herein provided. One complete test shall be made for each 200 bbls. or fraction thereof. Every test of cement which is used or intended to be used, in reinforced concrete construction or in non-reinforced concrete construction, shall be made by a cement tester who shall be satisfactory to the Bd. of Public Wks. and employed by the owner, architect, engineer, contractor or other person, firm or corporation constructing or erecting any building or other structure in the construction or erection of which any reinforced concrete construction or any non-reinforced concrete construction is used or intended to be used. Every such cement tester shall file with the Bd. of Pub. Wks. in the office of the Chief Inspector of Buildings a certified copy of all cement tests made by him. (The above substitutes for the first three paragraphs in the section as amended Dec. 8, 1912; the remainder of the section covering the rules for testing remain as heretofore.)

"Concrete Sidewalks, Pavements, Curbs and Gutters," a book recently issued by the Universal Portland Cement Co., covers briefly the underlying principles of good design and good construction and includes the specifications of the National Association of Cement Users, as presented at its Dec., 1912, meeting.



Uses of Concrete and Plaster on Mojave Desert.
Fig 1—Three Houses for Employees of a Plaster Company. Fig. 2—A Bath Room Shelter for Water Supply. Fig. 3—A Stucco School House. Fig 4—A Sleeping Pavilion. Fig. 5—A One-Room Cottage

Concrete and Plaster Houses Built on Mojave Desert

[It is only natural that a plaster manufacturing company should use plaster block and concrete in the construction of small houses for employees in the Southwest. The block are meant for interior partitions only. While the construction described is not to be endorsed, the data and the illustrations are interesting and full of suggestion in the concrete field.—Editors.]

The accompanying illustrations show an interesting use of concrete in connection with gypsum plaster in the construction of buildings on the Mojave desert at Amboy, Cal., and the block are said to make a very satisfactory dwelling in the hot, dry country in which they are used.

Fig. 6 shows a horizontal cross-sectional view of a plaster block. The block are made in 3- 4- 6- and 8-in. thicknesses about 18" high and 3' long. They are the product of a Sullivan block machine[1] and are made by the Consolidated Pacific Cement Plaster Co. at Amboy, for use in erecting small, inexpensive dwellings for employees. The reason for the use of the block is that lumber is very expensive. The drawings show semi-circular openings at the ends, *A* and *C* and a larger square opening in the center at *B*. When a wall is laid up two ends of block on the second tier come directly over the square opening in the center of the block below. Thus a continuous vertical space is formed in the wall. This is filled with concrete and sometimes reinforcing rods are also used, having previously been set in the low concrete foundations or footings on which the walls are built up. The concrete footing is made wide, projecting inside, and on this projection the floor rests.

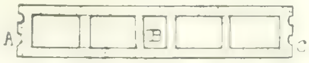


Fig. 6—Cross-section of Plaster Block. The vertical spaces formed by openings at *A*, *B* and *C* are filled with concrete and reinforced with rods which extend into concrete footing.

One of the interesting structures at Amboy is a concrete stucco schoolhouse (Fig. 3); having double roof extending far over each side thus forming a porch all around the building. The building is noted for its coolness in the dreaded hot months of summer. The inside is plastered, rough finish. This building was erected at a nominal cost.

Another illustration (Fig. 4), shows a sleeping pavilion made of the block and screen. Very little lumber is used in the structure, yet a most serviceable out-door sleeping porch is obtained. The top is made by laying the block on rafters of pine. The block form half of the height of the house, and the remainder is screened. Because the block are hollow, coolness is assured. The floor is 2' above ground. Fig. 2 shows a bath and wash house roughly made of block. It [illegible]

[illegible] to keep the olla of water cool. The block are laid in such way that the air has free play through the hollows. The olla can be seen in the center. On top of the bath house is a sleeping apartment, being one man's idea of a cool place to sleep.

A young man desiring a house of his own, started the little 8-ft. x 8-ft. house shown in Fig. 5. Leaving town, the house was left unfinished and the plaster company had it completed, and now charges about $2.00 per month rent for it. The interior of the house is the same as the outside, the walls being painted. The floor is of concrete. The roof is of heavy roofing paper. The little extension on the front is made by laying the block in place and bracing them by running boards across to the roof of the house. It is used for the wash basin. A glimpse of the olla protector is shown around the corner of the house.

Houses with two rooms, each 8' x 8' with concrete floors and block walls are being built for Mexican laborers at a cost of $125 each, rent for $2.50 a month.

Use of Missouri Mine Tailings Shows Big Increase

Millions of tons of chats—or mine tailings—are produced annually in the Flat river and Joplin lead and zinc districts. According to statistics collected by the Missouri Geological Survey, more than 2,700,000 tons have been utilized in the last year in building good roads, for concrete construction, and as railroad ballast. The material, as obtained from the mills, is in ideal condition for these purposes, the principal cost to the consumer being that of transportation. The mining companies sell the chats at $1.00 per car, or less than 10 cts. per ton.

The following table indicates the number of tons used for commercial and railroad purposes in 1911 and 1912:

	1911 Tons	1912 Tons
Southeast Missouri		
Commercial	273,544	258,623
Railroad	214,270	463,498
Total	487,814	722,121
Southwest Missouri		
Commercial	365,048	553,075
Railroad	650,741	1,449,207
Total	1,015,789	2,002,282
State Totals...	1,503,603	2,724,403

The total tonnage used in 1912 shows an increase of more than 80% over 1911. Although the production of tailings is approximately equal in Southeast and Southwest Missouri, only about 25% of the tonnage utilized is obtained from the Southwest mines.

Missouri today makes use of a greater tonnage of chats than any other state in the Union.

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[1] [illegible]

Cleveland Tests of Concrete Block

Interesting tests have recently been made in Cleveland by the Department of Buildings of concrete block manufactured in that city. A summary of the investigation is made by V. D. Allen, Inspector of Buildings, as follows:

In the early part of 1913, the Department of Buildings of the City of Cleveland gave considerable attention to concrete building block in order to determine whether or not these products were being kept up in their quality to the requirements demanded by the Building Code of the city.

As a result of this investigation the following information was obtained:

There are in and about the city of Cleveland approximately 30 plants where concrete building products are manufactured of which at the time these investigations were made about 20 were in active operation, with varying capacities from 100 block to 1,000 block per day.

All block are made of Portland cement concrete, the mixture varying from 1:3½ to 1:5, the sand being river, lake or bank sand.

In some of the plants the block were tamped with machine tampers and cured in steam, but the greater portion of the block were hand-tamped and air-cured under shelter.

In order to secure test block which would be representative of the ordinary product of the plant the inspector from the Department of Buildings visited the various plants unannounced and observed their methods of manufacture, quality of materials, etc., and marked from three to five block, giving directions that the manufacturer was to have absorption and compression tests made when the marked block had obtained the age of 28 days.

In cases where the plant was not in actual operation at the time of the inspector's visit he marked block from stock then on the curing racks.

All the tests were made in the testing laboratory of the Case School of Applied Science, Cleveland. Three block from each maker were submitted. The tests were conducted as follows:

The block were allowed to stand in a warm room until dry. They were then carefully measured and weighed, the absorption test consisting of first placing them face down in ½ in. of water for 30 min., after which they were weighed and then immersed in water for 4 hrs., weighed again, and immersed for 48 hrs. The percentage of weight in each case was computed from the dry weight of the block. After the absorption test was completed, the block were faced with plaster of paris, when necessary, and broken in compression while still wet. The absorption test showed very little gain in weight after four hours' immersion and in a few cases, an actual loss of weight after 4 hrs., due, no doubt, to some disintegration on the faces of the block.

The machine-tamped block showed a mean absorption in 48 hrs. of 5.57%, and a strength of 1,046 lbs. per sq. in. Hand-tamped block, an absorption of 8.04% and strength of 815 lbs. per sq. in.

There were about three times as many hand-tamped as machine-tamped block.

The steam-cured block showed an average absorption of 6.83% and a strength of 867 lbs. per sq. in., while the air-cured block showed an absorption of 7.52% and 794 lbs. strength per sq. in., there being about twice as many air- as steam-cured block.

Four sets of block made with river sand showed 8.17% absorption, and a strength of 692 lbs. per sq. in.

Three sets of block made with lake sand had an average absorption of 10.97% and a strength of 648 lbs. per sq. in.

Twelve sets of block made of bank sand showed a mean absorption of 6.27%

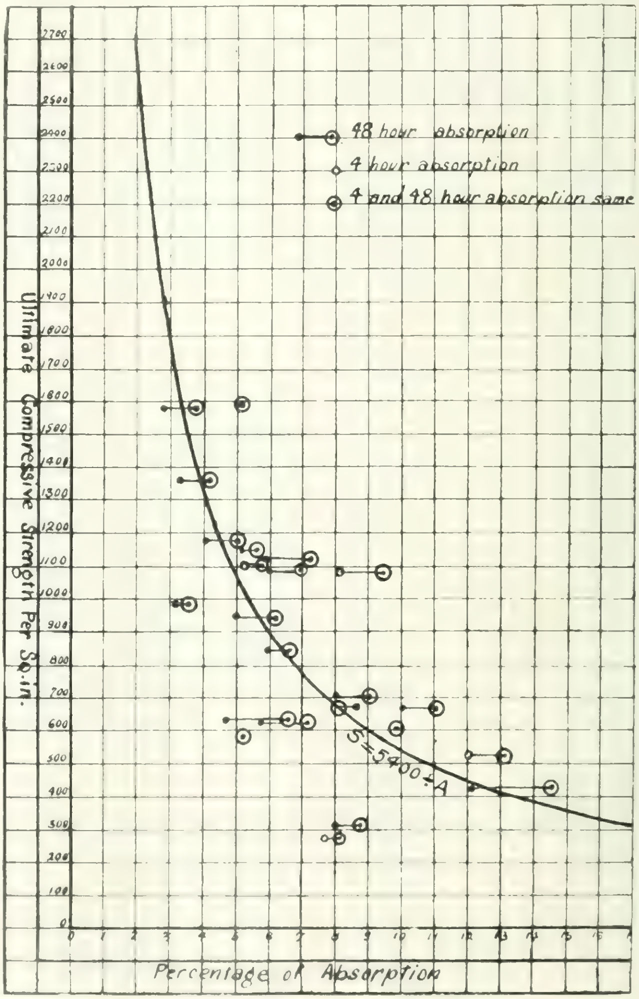

Figure Showing Results of Block Tests

and a strength of 1,034 lbs. per sq. in. The bank sand was evidently better graded than the lake and the river sand and produced denser block, as shown by the lesser percentage of water absorbed and higher crushing strength attained.

The lake sand in this locality is of uniform size grains and very fine and should not be used where a strong and durable concrete product is desired.

The advantages of a well graded sand are also evidenced in the unit weights of the concrete in the block. Block made of bank sand gave an average weight of concrete of 130 lbs. per cu. ft., the highest being 137; the lowest 122.

Lake sand, an average of 112 lbs. per cu. ft.; the highest being 119 lbs. and lowest 106 lbs. per cu. ft.

River sand showed an average of 120 lbs. per cu. ft.; the highest being 127 lbs. and the lowest 116 lbs. per cu. ft.

The block of greatest weight were machine-tamped.

The evidence gained by the inspection and tests seems to show clearly that block made of graded bank sand, machine-tamped and steam-cured, are the best. However, the advantages of this combination cannot be definitely claimed until more exhaustive tests have been made.

It will be the policy of the Department to continue making tests for a considerable period of time, the results of which will be carefully preserved for the better information of every one interested.

In order to have a graphic representation of the relation between the amount of water absorbed and the strength of the block a curve was plotted with the percentage of water absorbed as abscissae and strength in pounds per square inch as ordinates. A smooth curve drawn through a mean position of the plotted points gave an hyperbola having the equation Y equals 5,400 divided by X, or S equals 5,400 divided by A, where S is crushing strength in lbs. per sq. in. and A is water absorbed in per cent.

As a result of the investigations made by the Department, the Code governing concrete products has been entirely rewritten and materially modified. This is now before the Council for passage.

Some Further Tests of Oil-Mixed Concrete

Since Logan Waller Page, director United States Office of Public Roads, published the results of tests, showing that the use of an emulsion of water and oil in certain proportions in gauging concrete a product having a low degree of permeability was obtained, other tests[1] along similar lines have been made by Arthur Taylor and Thomas Sanborn. Mr. Page used eastern oils and Messrs. Taylor and Sanborn used western oils. The results of their tests are quite the opposite from those obtained by Mr. Page. The conclusions drawn from the later tests are as follows:

(1) Oil-mixed concrete containing 5%, 10% or 15% of oil, by weight of cement, is more permeable under pressures from 20 lbs. to 60 lbs. per sq. in. than concrete without the incorporated oil, and oil-mixed mortar containing 10% of oil is more permeable than plain mortar under pressures of 10 lbs. and 20 lbs. per sq. in.

(2) Oil-mixed mortars containing percentages of oil up to 25 show slightly less absorption of water than plain mortar, except that with the most viscous oils the mortar becomes more absorptive, and absorption is not an index of the permeability. The absorption decreases with the increase in the quality of oil.

(3) The tensile strength of oil-mixed mortar is decreased considerably below that of plain mortar. The strength decreases with the increase in the quantity of oil.

(4) The compressive strength of oil-mixed mortars follows lines similar to those of the tensile strength, but with a greater decrease in strength with the quantity of oil.

(5) The strength decreases with the viscosity of the oils, and with the most viscous oils it requires considerably more water to keep a mixture at normal consistency than is required in the fluid oil mixtures.

(6) The relative decrease in strength with the increase in the quantity of oil in mortars is less [illegible] days.

Details of Drainage and Foundations of Concrete Roads.

Roads being built today require close supervision over every detail of construction in order that their life may justify the money put into them. There are many little points essential to the success of Portland cement concrete roads, and these are so often overlooked that a mention of them at this time is advisable. My statements are confined to country roads where there are no curbs and gutters, but the construction of city streets is practically the same.

A foundation, dry and firm, with a covering which will not allow water to pass through it, is the chief characteristic of a road of the best type.

If the subsoil is of a character to retain water, it is very important that such a system of underdrainage be installed as will carry the underground water from beneath the road. In the dry summer weather this work may not appear necessary, but information should always be obtained regarding the action of the subsoil in the wet season and when frost is coming out of the ground.

There are, of course, many soils of a gravelly, sandy, or other character which are self-draining and do not require particular attention, but it is a fact that the defects in most of our country highways which are built upon clay soils or those which do not drain themselves, are to be attributed to a lack of drainage. There are two general methods in use to dispose of the water. One is to lay a 3-in. or 4-in. land tile under the shoulder and about 12 in. outside the edge of the concrete. The ends of the tile should be placed close together and clean stone of at least 1½-in. size put on the sides and top of the tile to a depth of 3″ or more. If there is any danger of dirt reaching and getting through the joints, the upper half of the tile at the joints should be covered with paper before the stone is put upon it.

The other method is to lay a French drain in the same position. With this type of drain the best results are obtained by placing in the bottom flat stones of 6-in., 8-in. and 10-in. dimensions. These should be laid in the form of a culvert and should be covered to a depth of about 6 in. with smaller stone of not less than 1½-in. size. The width of the ditch should be about 12 in. In both cases the depth of the bottom depends upon the character of the subsoil, but should in no case be less than 18″ below the finished grade of the road at the crown.

If the soil is such that water passes very slowly through it, lateral drains of the same type leading into the side drain will be necessary about 50 ft. apart, and possibly another longitudinal drain on the opposite side will be advisable.

When the back fill is thrown over the drain, it should be thoroughly puddled and compacted with hand rammers so as to prevent any settlement. With the water out of the way, the sub-base should be compacted until there is no creeping in front of the roller. The usual custom is to use a 10-ton roller run over the base once or twice, and call the job done, irrespective of the condition. Such a method compacts only a thin crust on the surface, and this is all destroyed before the concrete is placed. Better results can be obtained by using a lighter roller, say, of 5 tons. This will necessitate running over the road many times; consequently greater care will be exercised and a stronger sub-base will result.—W. A. McIntyre in [illegible]

It is something of a surprise to learn that a number of frame buildings which were utterly destroyed by the Omaha horror of last Easter are being replaced by frame structures of approximately the same character as those whose places they are taking. This repetition of what has been demonstrated to be a folly, is on a par with the action of the Italians who persist in undertaking to live in the volcano belt and who patiently rebuild whatever Vesuvius destroys, as their forefathers have done before them for generations.

Perhaps some of the people of Omaha figure that a tornado, like lightning, never strikes twice in the same place. Like lightning, it seldom has to in order to destroy. The behavior of concrete construction in the path of the twister throughout Nebraska was such as to indicate that it is immeasurably the safest to use in the cyclone belt. Eventually, dwellers in the breezy West will learn the economy and good sense of utilizing it, at least for their dwellings.

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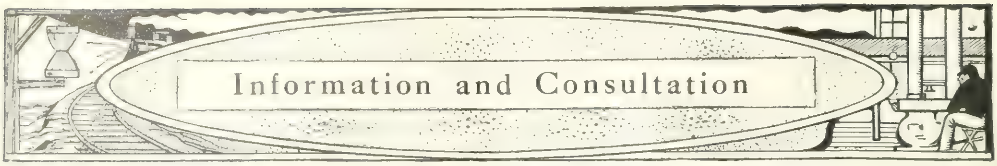
[1] Proceedings Am. Soc. C. E., Vol. xxxix, p. [illegible]



Information and Consultation

The Questions and Discussions in this Department are of interest and real value. Speaking for our questioners, we earnestly ask readers to discuss the questions submitted. For men in field and office, let this be a real consultation section, an exchange of ideas, among those who have, and those who have not, solved some of the problems of structural concrete. Questions and Discussions are cordially invited.

286. Concrete Floors in Soap Factories

"Do the fats and alkalies used in manufacturing soap have any effect on concrete wearing surfaces?"

286. Editorial Discussion

A series of tests is now under way by S. Canevazzi, an Italian engineer, to determine the effect of oils and fats on concrete surfaces. This question, of course, has a direct bearing on the above query. A progress report on this work published in a recent issue of *Le Ciment,* a French authority, shows that oils and fats act chemically on concrete surfaces to produce saponification. This saponification is a reaction of the calcium hydroxide in the cement with the olein, palmatin and stearin of the oil and results in a disintegration of the concrete. A report is made on the results of a two years' test of briquettes which had been immersed in olive oil. The 1:3 briquettes disintegrated completely. Parallel tests conducted at the same time with briquettes made of concrete to which finely ground puzzolana had been added developed little reaction and showed no decrease in strength.

Against the results of this test we have the actual facts of concrete floors being successfully used in soap factories with little or no reaction. Further discussion is looked forward to with interest.

* * *

305. Colored Mortar For Stucco and Plaster

"As a low-cost interior finish, would it be practical to mix one of these prepared 'cold water' paints with the mortar? Could mortar colors be used? Would this be applicable to stucco?"

305. Discussion by Rolf R. Newman*

I do not agree with C. R. Knapp in his discussion.[1] In my opinion he is wide of the mark, so far as the vital question of coloring wall surfaces of cement is concerned. The writer of the question under discussion has suggested a method of attacking the problem (for it is a problem, and a hard one) of coloring mortar and concrete, which is worthy of deep thought, full consideration, and careful experiment.

The art of mixing pigments with mortars to produce different colors is an old, and to a great extent a lost art. It flourished in Italy a thousand years ago, and yet Mr. Knapp, while he does not say it cannot be done, discourages any attempt along this line, partly because he does not believe that the cost would be as low as that of other methods, and partly because he believes it would be very difficult to do a good job.

If the questioner is willing and ready to take sufficient care in doing his work and realizes the possible difficulties which he should guard against, I think Mr. Knapp is entirely wrong in not advising him to do it in the manner stated in his question, or at least to try out the method fully on a small scale.

Regarding the possible difficulties, the questioner can find valuable advice in any good book on the subject of cement or concrete. One of the principal things to guard against is the bleaching of the coloring matter in the presence of lime. In other words, the coloring pigment should be "lime-proof."

From experience I know that certain mineral paints carried as dry powders by most paint or hardware stores give satisfactory results. Among these dry mineral substances I would mention Prince's red metallic, venetian red and yellow ochre—all three of which I have used with good success—the red metallic in concrete sidewalk and floor work, and the venetian red and yellow ochre in plaster and stucco work. In proposing to use "cold water" paints, your questioner must make sure that the stability of the color is not affected by the presence of lime.

Mr. Knapp makes so much of the fact that paint can be more readily applied to the outside of a cement surface that I would remind him that anything can be painted, from a chickencoop to a palace, with any liquid substance that will leave a mark. How long this substance will remain on is another question, but Mr. Knapp himself implies [illegible] applied [illegible] surfaces have not remained intact because he finishes his remarks by saying that "spots may be retouched with ease."

305. Further Discussion by C. R. Knapp*

Relative to Mr. Newman's criticism of my answer to this question, published in the April issue,[1] I will say that my answer was based on approximate cost, covering interior plastered walls only, which I understood to be the point the questioner wanted covered. Mr. Newman evidently has not caught the meaning that I wished to convey. A wall after the plasterers are through gets many digs by carpenters and other workmen and has to be patched before the house is entirely finished. To patch these with colored mortar without showing different shades of color is the problem. Suppose a patch is needed after a year, what would be the chance of matching the colored mortar and doing a job that would not show? This is one of the disadvantages of this method and is why I advise against it. If regular mortar is used, a smooth job can be done and then by tinting the walls with water color you have virtually the same effect at a less cost. I like to see colored mortar myself, but there are some facts that one must look directly in the face.

* * *

309. Concrete Bridges to Withstand Flood, and Their Comparative Cost

The flood which occurred here recently has demonstrated the fact that steel bridge construction with stone abutments will not stand the test of permanency. Our tax payers consequently are beginning to feel the need of some education along the lines of bridge construction, as our county lost 30 bridges of steel construction during the recent floods.

"I have been asked to furnish some reliable data on this subject for the benefit of some of our large tax payers. Having this task on my hands, would you kindly furnish me with facts in regard to the comparative cost of rein-

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[1] [illegible]

*Bldg. Contr. Albany, N. Y.

forced concrete bridge construction as against steel construction with stone abutments."

[This is a query coming from the flood district of Ohio. It was referred to bridge engineers; and the following is the first discussion that has come in —Editors.]

309. Discussion by A. M. Felgate*

In regard to the relative value of steel and concrete bridges, I would say that each particular bridge is a problem in itself and it is very seldom that one bridge is suitable for more than its own particular location. If the location of any given bridge is such that sand, gravel and cement can easily be transported to the site it can be shown that a concrete bridge is a cheaper proposition than a steel bridge. The concrete bridge can cost 20% more than a steel bridge of equal capacity and still figure out to be cheaper in the end on account of lack of repairs and of depreciation.

In this county we have eliminated 80% of our steel bridges and the recent floods have not caused any damages to our concrete bridges. Seven or eight steel bridges have been destroyed and where it is possible to replace these with concrete bridges the work will be done.

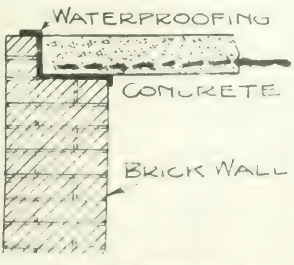
There are, however, some locations where a concrete bridge is not suitable. If the bottom is very soft it is quite expensive to build concrete arches as so much masonry must be put in the abutments to provide for the horizontal thrust and with an arch construction it is difficult to get sufficient area of waterway.

I should strongly advise any community to replace all bridges with concrete structures wherever possible. I would also state that the services of a competent and experienced engineer whose record is such that it will command respect be employed. The expense of this service will be amply repaid by eliminating mistakes that will be costly to future generations.

* * *

306. Waterproofing Walls at Floor Levels

"We have had some trouble due to a discoloration of the exterior of brick walls, particularly at the floor level. Is this due to the lime in the concrete floor? Would the method as suggested in the accompanying detail help? We are planning to use hot tar as a waterproofing material."



Waterproofing a Floor Seat in a Masonry Wall

308. Discussion by W. C. Boynton*

The presence of efflorescence or whitish deposit indicates that either the brick work or the mortar, or both, are porous. When rained upon, the entrance of water into the joints causes a consequent leaching out of the uncombined carbonate of lime or other soluble salts which are left as deposits on the surface of the work after the evaporation of the water.

We quote from Baker's "Treatise on Masonry Construction," p. 181, the following:

"Masonry, particularly in moist climates or in damp places—as cellar walls—is frequently disfigured by the formation of a white efflorescence on the surface. This deposit generally originates with the mortar but frequently spreads over the entire face of the wall. The water which is absorbed by the mortar dissolves the salts of soda and potash, magnesia, etc., contained in the lime or cement, and on evaporating, deposits these salts as a white efflorescence on the surface. With a lime mortar, the deposit is frequently very heavy, particularly on plaster and usually it is heavier with natural than with Portland cement. The efflorescence sometimes originates in the brick, particularly if the brick be burned with sulphurous coal or is made from clay containing iron pyrites, and when the brick gets wet the water dissolves the sulphates of lime and magnesia and on evaporating leaves crystals of these salts on the surface. Frequently the efflorescence on the brick is due to the absorption by the brick of the impregnated water from the mortar."

The following is quoted from the American Civil Engineers' Pocket Book, in referring to the same subject, p. 524:

"As a preventive, make the wall as impervious as possible by using a rich mortar, (preferably of Portland cement), mix it well and fill all the joints solidly full. If the wall stands in damp ground one or more of the horizontal joints should contain a layer of hard paper or bituminous felt to prevent the walls absorbing moisture from below. Particular care should be taken during the erection of the building to see that the roof cornice and gutters are made water-tight and all ducts that carry water or steam pipes should be waterproof on their inner surfaces."

In repairing existing work, first remove the efflorescence by scrubbing the surface with wire brushes or by the use of ordinary scrubbing brushes and a solution of hydrochloric acid, the hydrochloric acid mixed with at least four or five times its volume of water. Before applying the acid, the wall should be well dampened, and after being scrubbed the wall [illegible] with clear water. Then use the following treatment which is suggested in the above mentioned book

"The face may be rendered impervious by the application of one or more pairs of the Sylvester washes, which will not materially darken or discolor the brick. The Sylvester washes consist of an alum solution made by dissolving one pound of alum per gallon of water and soap solution made by dissolving 2.2 lbs. of reasonably pure hard soap per gal. of water. The brick masonry should be cleaned and dried and not colder than about 50° F. The special wash should be applied boiling hot but the alum solution may be 60° to 70° F. when applied. One wash should be put on and allowed to dry for 24 hrs. when the other is applied. The above washes have long been used for rendering masonry impervious but instead of using alum as above it is better to use aluminum sulphate which is cheaper than alum and only two-thirds as much is required."

306. Discussion by A. T. Portersfield*

The discoloration is a white efflorescence which forms on the face of brick or concrete work. Its cause is not confined to concrete work alone. Almost any brick wall where the bricks are pervious to water will show this discoloration, some brick being worse than others, depending upon their composition. There are at least two principal substances which may cause this efflorescence. Carbonate of soda is the most common after the lime stains have been removed. This is produced by the action of the lime upon the silicate of soda and is brought to the surface by capillary attraction before the concrete or mortar has become thoroughly dried out. Pervious face brick may show these white crystals after a driving rain storm several years after being in place.

Another efflorescence of importance is composed chiefly of sulphate of magnesia. In burning the alumina or clay in both brick and cement manufacture, the pyrites give rise to sulphuric acid and this latter unites with the magnesia. In the case of brick, the sulphuric acid unites with the magnesia of the lime mortar.

As to the prevention of this efflorescence we have found that a good hard burned impervious face brick gives about the best results for practical purposes. The method suggested by the sketch would undoubtedly give relief from the excessive efflorescence, which would otherwise come at the floor line, but it would not overcome the difficulty if the face brick themselves were pervious. Waterproofing coats applied to the surfaces of walls are supposed to prevent the efflorescence from crystallizing thereon, but this method is not wholly satisfactory.

Water vigorously applied with a wire brush will remove these stains. A weak solution of muriatic acid will help in removing the efflorescence if applied carefully. The surfaces should be [illegible] other means immediately after scrubbing with the acid, as the acid, if left, is injurious to the surface.

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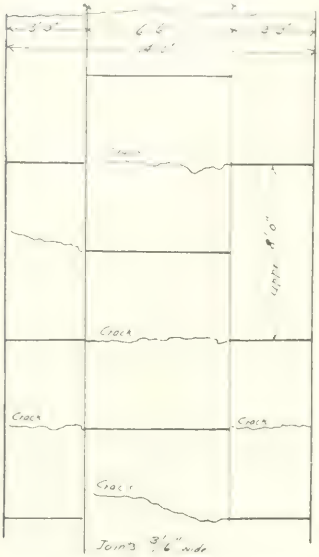
*Bridge Engr., Cuyahoga Co., O. (Cleveland)

*Universal Portland Cement Co., Chicago

*Architectural Engineer, 5415 Lexington St., Chicago, Ill.

292. Cracks in Concrete Sidewalk

"I am enclosing herewith a sketch showing the jointing plan of a granitoid walk, 14 ft. wide, which I built lately. When the architect showed me this plan, I told him that these joints would crack through the adjoining block, as shown on sketch. He laughed at me. Nevertheless, they did crack through. I have noticed this to happen almost every time. Is it caused by expansion or something else?"



Sketch Showing Arrangement of Blocks in Sidewalk

292. Discussion by M. S. Hotchkiss*

The inquiry in a recent issue, respecting the cause of concrete sidewalk cracking, and the discussion[1] taken up by John McGrath, were noted by the writer.

In my opinion, if a concrete walk had an efficient perpendicular expansion joint around each slab, this trouble would never have happened. The necessity for expansion joints has always been apparent, since the introduction of concrete as sidewalk material. These joints have been made in many different ways. Monolithic construction in this class of work is out of the question, and always has been. Contractors have devised ways and means for attempting to secure an adequate expansion joint, which in fact, was not an expansion joint but a division in the work. It has been taken up by engineers, and particular specifications made regarding the expansion of a concrete walk. One of the popular ways was to construct work in alternate sections, and when these sections were thoroughly set the intervening spaces were filled in, and a strip of tarred paper, or something of that nature, placed between the two sections. Another method was to put in beveled strips and leave them in the concrete, letting the strips come ½" below the surface of the walk and cutting the joint directly over this strip. Another one of the methods which was used was to cut the concrete with a knife, and fill the groove thus made with sand to procure this joint and division of a block. I might enumerate several methods for making divisions and expansion joints, but there were always objections which would show up in these various ways.

In the first place, where alternate blocks were specified it meant considerably more work, as it necessitated forming up for this work twice, practically going over the ground the second time. The extra labor made this expensive to the contractor, and then he did not secure the desired result. He made a division but not an expansion joint, as the concrete was always in close contact with the previous alternate section. Hence the slabs of the first section being lifted by the frost action, or any other force, and binding so closely to the second section, would produce the crack opposite the division of the first section. In the second instance where beveled division strips were left in, it was necessary that these wooden strips be always well soaked with water, otherwise the absorption of the water from the concrete would swell these strips and make trouble, so that in this instance there was no expansion joint, but simply a division. It also quite frequently happened that the workmen would not be particular in cutting these joints directly over the dividing strips, as the division strips might be carelessly tamped to one side of the marks indicated on the side rails. This made more trouble, and cracks would always develop wherever the dividing strips were at one side or the other of the grooving line.

As to the use of a "grout knife" I have one of these. It has been hanging up in my barn for nearly 20 years. The difficulty with this is that if the aggregates of the concrete material happened to be somewhat coarse, the coarser aggregates would have to be shoved to one side, in order to force the knife through the concrete, and this would make trouble. The groove thus cut did not always prove to be the straight line that was intended, and the irregularity of this sand-filled joint did not make an expansion joint which would permit the free action of the abutting slabs.

Since the introduction of steel forms, however, this entire proposition has been wonderfully simplified. Every joint is perfect, every joint has space and allowance for expansion, and is perpendicular with the work, so that if one slab does happen to raise from the action of the frost, it will free itself from the adjoining flag. So that with the introduction of steel forms for this class of work we have overcome every objection in connection with adequate provision for expansion in this class of construction.

We no longer need a specification which requires us to lay concrete walks in alternate sections. We no longer need to provide beveled strips for these expansion joints. We have no further use for the "grout knife." It is not necessary to put in fillers and cut the work with a trowel. Steel forms have revolutionized this construction. If steel forms and good honest materials are used in sidewalk construction, there should be no fear of cracks.

"Concrete is its own inspector"—if it is given time—but it is rather a slow inspector. If there are any defects they will eventually show up, but usually the inspection must be in time to see the defects before the work has been approved. The best inspector in our opinion is steel forms in the hands of an honest contractor.

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[1] P. 180, April, 1913, issue

*[illegible] hamton, N. Y.

312. Flood Area of Concrete Bridges

"It has recently been brought to our attention that open spandrel bridges are to be recommended for any district subject to floods in that they afford a greater flood area by allowing the water to flow through the open spandrels. Is this of sufficient importance to advance further the use of open spandrel work on the smaller country bridges?"

312. Discussion by A. W. Buel*

In my opinion the use of open spandrels to afford greater flood area is of sufficient importance to justify their use in cases where local conditions are such that open spandrels can be used to advantage. In other cases, where the span is very short, or where the spans are relatively short with extremely flat arches, it is evident that there might not be sufficient gain in the stream or river prism at the bridge to justify the complication of open spandrels.

Therefore, each case should be passed upon by an experienced and skilful designing engineer.

Even modern Chinamen have abiding faith in the universal adaptability of bamboo as a structural material. The canes are used for everything that the Chinaman has required since the time of Confucius. An effort will be made to utilize them now in connection with the world's most modern building material, Portland cement concrete. Experiments are to be made by a Chinese student at the Mass. Inst. of Tech. in which bamboo will replace steel in reinforcing concrete. Whether or not anything of value results from these tests, the experiments ought to be interesting.

Fire destroyed the plant of the Mankato Cement Works at Mankato Minn., June 9, entailing a loss of $53.000. The plant was one of the city's largest manufacturing enterprises and will be rebuilt at once.

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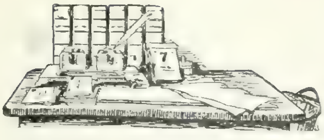
*Cons. Engr., 15 William St., N. Y. C.



CORRESPONDENCE

Comparative Efficiency of Super-Hoppers and Side Loaders for Batch Mixers.

From several years' observation I have come to the conclusion that a side-loading mixer is not an economy when it is possible in any way to get the mixer down into the basement of the building. The side-loaders are slow because it takes time to take a dry batch out of the hopper into the mixer after it is tipped up.

Within the past year, we have had a striking illustration of the comparative value of two set-ups. On a building completed last summer we used a small 1-bag mixer. The mixer was set down at the basement level and the hopper was built over the mouth of the mixer with the top of the hopper at grade. The concrete materials had to be wheeled and dumped into this hopper and a complete batch was discharged into the mixer by opening a gate at the bottom of the hopper.

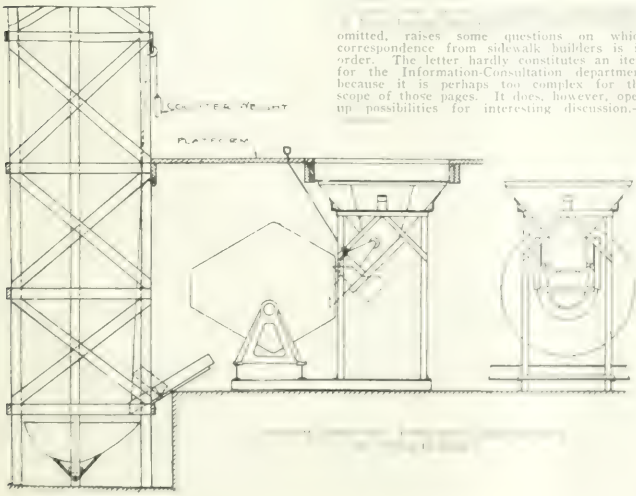
Fig. 1 shows the essential features of this set-up. The hopper was one of the regular type manufactured by the T. L. Smith Co.[1] and was the same kind as is used to handle concrete up on the floor. A special attachment for this use is a short chute pivoted as shown. When the drum dumped this chute was raised up. When it was required to empty the hopper into the drum a man stationed above pulled up the hopper gate with a wire through the floor of the platform, and the weight of the material struck the chute and turned it down into the mouth of the mixer

This outfit was very rapid indeed. We have run 140 yds. in 9½ hrs. with six men as a mixer crew, one man above handling the water, dumping the hopper into the mixer, dumping the mixer and handling the little discharge chute in front of the mixer. One man handled the cement and four men wheeled the gravel with a 6-ft. to 30-ft. wheel. Our average run here would turn out a batch in 45 sec.

On the other hand we are now using a bigger mixer of the same make with a side-loader attachment and I believe if we had to we could turn out more material with the old equipment. The only advantage the side-loaders have, it seems to me, is that they require no wheeling up an incline. If the mixer itself can be placed below grade a super-hopper arrangement of some kind is in nine cases out of ten more economical than any other practical arrangement.

[illegible]

Detroit.



[illegible]

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[1] Milwaukee.

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Sidewalk Construction—Some Questions*

In building a 16-ft. sidewalk with a bottom course specified 5" thick and 1 in. finish, would there be a surplus of mortar in the 1:2:4 mix for the bottom course which when tamped would come to the top to make a finish equal to the 1-in. specification finish? Or is it necessary to mix 1:2:4 and then on top of each batch *as laid* pour a top coat special mix 1:2? I am party to dispute on sidewalk construction and the points arising are:

Our claim is that it is *not* necessary *immediately* to pour a top coat on the concrete as laid. Is it not sufficient and more advisable to lay batches of concrete, say 100' of sidewalk, tamp it so water will come to top, than to put on a finish of 1:2 mix? Would it not make a good job, *without any* top finish, in view of the fact that the mix is to be 1:2:4, with ¾-in. stone (well tamped so that mortar will rise to top), and very coarse Cow Bay sand?

The material—cement, sand, stone—is put through a ¾-yd. mixer, then laid; now if followed up instantly by top coat, would not the top coat prevent water rising to top, from the concrete in the bottom course, for several hours, and prevent working of top coat by finishers? Would not this method make the result a less desirable one than with the following method: Pour concrete 5" deep over a surface 100' x 16'; pour 1:2 mix as a top finish coat, then put finishers at work "screeding" it down; allow it a couple of hours to float, then final set to trowel. Is cork float or trowel finish the best method? Is "tamping" with surplus of mortar coming to top as good as the 1-in. finish? It seems to me that it is a waste of material to mix 1:2:4 and while it is fresh laid, cover it immediately with 1:2 mix, because enough mortar will arise from tamping to make finish without putting on 1:2 mix. I should say the sand we use is 30% grit.

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*[illegible] omitted, raises some questions on which correspondence from sidewalk builders is in order. The letter hardly constitutes an item for the Information-Consultation department because it is perhaps too complex for the scope of those pages. It does, however, open up possibilities for interesting discussion.—[illegible]

A Trade School Concrete Course

The M. C. M. A. Evening Trade School was established several years ago by the Massachusetts Charitable Mechanics' Association, and it is the only school in Boston where masonry is taught. For the first few years, no tuition fee was required, but the pupils are now required to pay a small sum, although the school is by no means self-supporting.

The school is essentially an Improvement school for apprentices. Under present conditions of specialization it is impossible for an apprentice to learn all the branches of his trade and our aim is to increase his efficiency. John W. Wood, who is also Principal of the Rindge Manual Training School of Cambridge, is the supervisor.

I have been in charge of the masonry classes for the last six years and have taught all branches of masonry in that time. The concrete line was introduced in a small way two years ago and met with such enthusiasm among my pupils that we have given more time to this work in the last term and plan to do even greater things next year. In this connection, William O. Lichtner (associated with Sanford E. Thompson) delivered a course of lectures that were open to the public, free of charge. The attendance was composed largely of foremen and superintendents engaged in construction work and it will be necessary for the Association to provide a large lecture room for the coming year.

Mr. Lichtner is preparing text-books for this work next year and we plan then to give more time to the subject. Now, in regard to the practical work in concrete, it is outlined as follows:

Actual concrete construction.

[illegible]

[illegible]

Mixing and pouring concrete.

First exercises—

Small columns, beams and slab sections.

[illegible]

Erection of unloading platform 9' x 5' [illegible] girder, beam and slab construction. This platform is used in unloading materials to be used in the school.

The lectures are further illustrated by means of small columns and beams, plain and reinforced, showing the advantage of using steel rods.

As this line of work is a new one in the school, I shall be pleased to receive suggestions in regard to it.

D. EUGENE LUKE,
Instructor in Masonry,
M. C. M. A. Evening Trade School,
Boston.

* * *

The Development of Concrete Block—Wet and Dry Processes

In regard to difference in strength between poured and dry tamped block we think that the dry block is fully as strong as the slush. Of course we do not make our tamped block dry, by any means, we make them so wet that water shows on the block when taken from the machine and also on the machine itself. If the block makers would see how wet they could make their block instead of how dry, a great deal of trouble would be saved. A mixture wet to a certain extent will stick to a block machine, but make it a little wetter and it won't.

We make concrete tile and block. At first, our block business was merely a side line, but we have made 60,000 block this year, and expect to make more than that number more, before the year is over.

We have three different machines, The Eclipse,[1] the Anchor,[2] and the Zagelmeyer[3] cast stone block machine. We can make a tamped block much cheaper than the poured, as it takes longer to take off molds and put them back together on the slush machine. However, the slush machine has them all beaten for a good rock face.

We steam cure all our block for three days, and we have loaded 1,500 in a car right out of the curing rooms and not had a block broken in shipment.

J. H. MAYER
Humboldt Cement Products Co.,
Humboldt, Ia.

* * *

Bagged Concrete Materials and Small Mixers

The formula for concrete 1:2:5 or 1:3:4, etc., is really meaningless, as the fineness of the sand and the size of the gravel vary with every location. The strength of the mixture being dependent on all the interstices being filled, surely a more accurate way of getting the proper proportions of each part of the aggregate is necessary. The usual way of having the teams unload their sand and gravel in piles near the job, usually in the dirt, and then having the barrow men load it into the mixer is certainly very uncertain, as some of the barrows will contain more than others.

My idea of producing a perfect concrete is to have a plant, where all kinds of sand, gravel, crushed rock, slag, etc., are washed and then mixed in the particular proportions desired for each purpose. Then the contractor could send in his order for just what he wants, and not depend on unskilled, unreliable labor for it.

But it is known that however well it may be mixed in the mill, the jolting of hauling it to where it is to be used will separate it, the finer part sinking to the bottom and the coarser rising to the top. This separation may be prevented, however, by hauling the mixed material in bags. These bags can be returned the same as cement bags.

Many great advantages would result to the contractor. The mixing mill would have experienced men to see that the exact proportions desired of each particular part of the aggregate were supplied. Holding it in bags until used would insure its being kept clean and in its right proportions, and handling it in bags would revolutionize the process of mixing.

I recently watched for some hours the laying of a concrete sidewalk and gutter around a business block. The contractor had a large batch mixer on one side of the block, and the mixed concrete was wheeled in about 20 barrows around the block. By the time it reached the place wanted, the segregation of the materials left muddy water at the top, and concrete at the bottom. The concrete was set so hard that it had to be shoveled out, and the best strength of the cement was lost.

A better plan would have been to have several small mixers, and wheel them right to the spot wanted, and unload bags of sand and bags of cement adjacent to the mixer, thus saving expense of wheeling the concrete and securing a much better result.

This suggested plan of a small mixer and handling the aggregate in bags is especially desirable for one-and two-story buildings construction. I raise the mixer on a platform above my work, and let the concrete run by gravity in troughs from the mixer to molds where wanted, thus securing all the strength of the cement, by getting it in place before initial setting, and save expense of an elevator, as the bags can be pulled up on a pulley, and the water is carried up by the hose.

Welcome the sand washing and mixing mill, and bag delivery!

A. M. LAPHAM,
Glendale Park, St. Louis County, Mo.

* * *

Economical Concrete Posts

For the future water supply of the city of New York the Board of Water Supply is constructing large reservoirs for collecting and holding the water to be transported to the city through conduits now under construction. More or less fencing is necessary to enclose property holdings and water basins formed and concrete posts were decided upon.

Various styles of corner, end and gate posts as well as line posts were designed by the engineers for a total of more than 55,000 concrete posts, undoubtedly the largest number contemplated by any user up to the present time, contracts being let about the middle of 1912 for the various sections. Corner, end and gate posts were designed substantially square in cross-section, in 8-ft to 9-ft. lengths, reinforcement consisting of various sizes of square twisted bars, or equivalents if approved.

Two types of concrete line posts were designed, these being one of "T" shape (Fig. 1) and one triangular in cross-section (Fig. 2), and two styles of each, one reinforced and the other having a steel core, the latter style being shortened when necessary, and set with the steel core in a hole drilled in rock for stability, the reinforced post being used in the customary way by digging or blasting holes for setting. These line posts are computed to weigh from 100 lbs. to 125 lbs. each, length designed 7′ 3″.

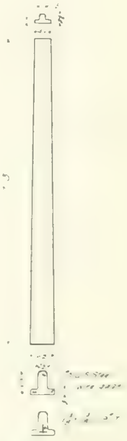
Fig. 1

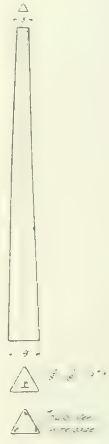
Fig. 2.

Types of Line Posts Designed for New York Board of Water Supply

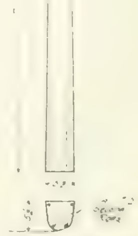
Fig. 3—Type of Post Used Extensively in Fencing New York Reservoirs

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[1] Geo. C. Christopher & Son, Wichita, Kans.
[2] Anchor Concrete Stone Co., Rock Rapids, Ia.
[3] Zagelmeyer Cast Stone Block Machinery Co., Bay City, Mich.

The design of post shown in Fig. 3 has been approved for use in connection with the Aqueduct fencing, and will be used in considerable quantities instead of the former designs originally specified, on account of the ease and speed of making, and the economical practical construction.

The cost estimate for these posts will be about as follows: Four No. 5 wire rod reinforcements, weight 3 lbs., obtainable at a fraction over 2 cts. per lb.; with a 1:4 mixture a yard of gravel will make about 32 posts, and barrel of cement, 20. Labor will run from 3 cts. to 5 cts. each, which with the average price of cement and gravel will make the cost in the neighborhood of 20 cts. each, or an average price for short-lived wooden posts in most localities They can be made with common labor in the locality where used, the machinery is easily transported and materials for their manufacture are found in most localities.

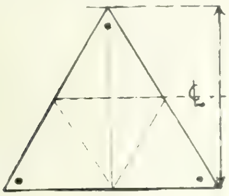

Fig. 4

An objection to the triangular post might be best illustrated by a quotation from a report of investigations and tests given in Bulletin 148 of The Colorado Experiment Station (Pp. 32-33):

"The three-cornered post, which is advocated to some extent, does not have as many points in its favor as it may seem. In the first place an equal amount of reinforcement in each corner of the post cannot make a post of equal strength from two opposite directions. If a force is brought to bear against one of the flat sides of the post towards the opposite corner, the material in the corner will crush long before the wires will break on the side from which the force is exerted. On the other hand if a force is brought to bear against one corner of the post towards the opposite flat side, the single reinforcement in the corner will break before the mixture has begun to crush on the flat side.

"An extra reinforcement in the corner on which the force is exerted towards the opposite flat side will make it practically as strong as the flat side. But when the force is again applied to the flat side towards the single corner which is doubly reinforced, the mixture in the corner gives way too soon and it is no better than with but a single reinforcement."

"The best form of post is one which is equally strong from all directions. The square, or round post, fulfills this requirement. The triangular does not meet the requirements because it cannot be economically constructed so as to be equally strong from all directions."

The reason for this is quite apparent when the principles involved are considered. The concrete is to withstand the crushing strain, and the steel reinforcement to withstand tensile strains. Thus the larger the cross-section of concrete in compression when the post is strained, and the more nearly equal in relation to the placing of the reinforcement, the more economically the post is constructed.

Referring to the sketch in Fig. 4 it will be noted for instance that dividing the post halfway between the point and the opposite flat side, there is only ⅓ as much concrete in the point half of the post as in the flat side half, and only ½ as much reinforcement; thus it will show only ½ as much tensile strength, and only about ⅓ as much crushing or compression strain. To make it as strong against tension it is necessary to add another reinforcement, and to compare in crushing strength add additional concrete to make it practically square. If one is going to the expense of making a permanent structure he should not spare any slight additional expense in constructing it most economically.

What is true of the triangle shape is more defined in the "T" shape of post as they do not have even the ⅓ as much concrete in the point as in the flat side. It is not policy to try to save upon amount of materials at a loss of required strength, and while it might seem quite expensive to fill a square mold of the same dimensions as a triangular post, it must be realized that with the larger cross-section, a coarser aggregate concrete may be used, thus getting greater efficiency from the aggregate with very little if any additional expense. The additional gravel used is inconsequential in cost, the only objection being slightly additional weight, which is absolutely necessary for any additional strength. Additional weight is a factor of stability when the posts are once set. With the nearly square post it is not necessary to screen out all the coarse gravel.

[illegible]

Secretary and Treasurer
D. & A. Post Mold Co.,
Three Rivers, Mich.

* * *

Hassam Concrete Pavement*

The so-called Hassam pavement is in its present form the result of many experiments made by W. E. Hassam, while he was superintendent of streets of Worcester, Mass., and since, after it was found that the method put into practice by him as an official had a large commercial value; it was found in practice that ordinary mixed concrete used as a foundation for brick or stone block pavements failed to meet all the requirements. It was found, for example, that it was difficult to obtain a perfectly uniform surface on which to place brick or stone blocks and have it at the same time of uniform density or with a uniform distribution of ingredients. When the concrete is laid for foundations of piers or buildings and the mass is of great depth this fact is not of great importance, but when only a thin layer on the sub-grade of a road or street was required, it became of serious moment. It will be recognized that owing to the different specific gravities of the various materials composing the concrete mass, there will be a separation of the parts before the cement is set; this is particularly observed when a batch of concrete is transported in a wheelbarrow or cart; the shaking of the mass, even when run over a good roadway or plank, settles the aggregate to the bottom and leaves the cement mortar on top. Dumping a barrow or cartload still further disturbs the relation between them. Each load that is dumped is more or less different from all others and there is greater density in some portions of each load than in other portions, so that as a matter of fact it will be found on examination of concrete laid on the sub-grade of a road or street that masses of stone with a comparatively small amount of cement and sand will result and in others cement and sand and very little rock; in short, no two adjoining sections will have the same amount of the specified ingredients. This condition is but little helped by ramming or tamping. The practical result is that two unsatisfactory conditions are manifest, viz.: that the surface of the concrete foundation is uneven, and the sustaining strength of the concrete is never the same in all parts of the road. These conditions led to a series of experiments in order to obtain for stone block, brick or wood block pavement an even foundation of uniform strength, which would secure a smooth final surface and would hold its shape indefinitely. It was found after many trials that the most satisfactory, if not, indeed, the only way to obtain all the necessary characteristics for such a base was as follows: Broken stone sufficiently tough to withstand the weight of a 10-ton roller when run over it enough thoroughly to compact it, is placed upon a properly prepared sub-grade and it is rolled until thoroughly compacted. This stone should be of [illegible] carefully placed that after rolling it should present a perfectly uniform cross-section, rough because of the large size of the individual stones, but uniform in shape both longitudinally and laterally. The voids between the stones are thus reduced to a minimum; a cement grout composed of 1 part hydraulic cement to 2 or more parts of sand and sufficient water to secure an easy flow, is then distributed evenly over the stone placed [illegible] done [illegible] the machine invented for the purpose.

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*[illegible] request for some detailed information as to this type of pavement. Now that there is so much interest in concrete paving progress and comparatively little information generally available as to this particular type, we believe that what Mr. Parker has written will be interesting to many readers in that it explains the ideas which led to this particular development. Reports of Hassam paving done in various places will be found in the tables published in the Sept., 1912, issue and on other pages of that issue as noted: Lynn, Mass., Portland, Me., (also [illegible]

Before the grout has begun to set the whole is thoroughly rolled again. This is done to force the grout into every void and to drive out any air, making the whole a monolith. This process compresses the concrete from 15% to 25% as compared to ordinary mixed and tamped concrete; in other words, the same amount of material will occupy from 15% to 25% less space; moreover, every square yard of surface will have exactly the same amount of stone under it with an exactly uniform amount of cement and sand. A pavement laid on such a foundation never gets out of surface, except by the wearing away of the surface itself; depressions in the road never appear by reason of settlement or lack of uniformity of the foundation—all parts are of equal strength. Very careful comparative tests of the above method and ordinary tamped or rammed concrete, of identical composition, were made under the direction of the Worcester School of Technology physical laboratory. These tests show about 50% greater crushing strength in favor of the Hassam process.

The foundations laid as I have described were found to be so nearly uniform in shape and so nearly indestructible in character that where traffic was not too severe, it was adopted as a completed road and many hundreds of thousands of yards have been laid with entire satisfaction, the only criticism possible being that surface cracks appear unless great care is taken to protect the top until well set. Such cracks do not reduce the strength of the road, but they are unsightly and sometimes chip on the edges. So-called expansion joints will not prevent the occurrence of such cracks, because the cracks are the result of contraction and not expansion. This is the difference between the foundation I have described and the same method used as a finished road, viz.: that the distribution of the grout should come upon the stone and not on the grout. This can be done by brushing with wire or other coarse broom before the cement is set, the brushing to be done from side to side and not longitudinally. A smoother top can be obtained, of course, by flushing the surface with a richer grout.

A road built in this way is, of course, somewhat dusty, and more or less noisy, it is also rigid and hard on horses' hoofs, but not slippery.

In order to overcome these objections, experiments were made in using tar or other bituminous compound to cover the surface. These experiments began as long ago as 1906 with ordinary gas-house tar, put on with pails and brooms. It was found that this tar so applied was stripped off and at the end of a year of fairly heavy and varied traffic most of it had disappeared. Since then many trials have been made and as a result, my own view is that the following produces the best road surface: The concrete road made as I have outlined must be thoroughly cleaned, washed if possible so that no dirt or foreign matter remains in it; while the surface is still slightly damp a coal-gas or water-gas tar, refined but with some of the volatile oils still remaining, should be applied to the surface by means of a machine that will force it onto the road under pressure of 70 lbs. to 80 lbs. per sq. in., with the nozzles of the machine within 6" of the road. This application should not exceed ¼ gal. to the sq. yd. Immediately after this application is made it should be evenly covered with stone chips and rolled with a light steam roller; after brooming off the loose chips, another application of heavier tar or preferably asphalt also under pressure and a little more in quantity (from ¼ gal. to ⅜ gal.) should be made, this layer also to be immediately covered with stone chips or coarse sand, and again rolled. The advantage of this road is that it combines durability with economy.

My experience in the construction and maintenance of roads is, that the combination of horses' hoofs shod with iron, steel-rimmed wheels and swiftly moving automobiles will destroy roads faster than we can build them unless something is used which will prevent disintegration. For this reason, modern road builders have been trying to discover some material so to bind together the component parts of a macadam road that they will not be scattered by modern traffic. Every kind of oil, asphalt and tar in various combinations, has been employed in as many ways as the ingenuity of man could devise, but while no man can convincingly claim that he has the final solution of the problem, some are undoubtedly nearer than others. My own argument is that a broken stone road permanently held together by an hydraulic cement matrix is not only permanent but becomes stronger with age, if it is protected by a thin wearing top which can be replaced at nominal cost when necessary; and the desired end is more nearly reached than by bituminous mixtures combined with stone, from 2 in. to 4 in. in depth. It must be perfectly clear that a properly made structure composed of uniformly tough rock firmly held together by a material nearly as indestructible, is the best known method for securing a permanent road, short of grouted stone blocks.* This road can then be improved and perfected by a top of bituminous material, that resiliency and freedom from dirt and dust may be secured at small additional cost. The maintenance of such a road is inappreciable. I have a statement from Mr. Johnston, division engineer of the Massachusetts Highway Commission, that the state under his direction has kept in perfect condition Hassam concrete roads built seven years ago, and covered with ½ in. of bitumen, as I have described, over three years ago, for a total outlay of $30 for 4,000 lin. ft. of road, in the last three years. In short, the road so built is practically indestructible, and the thin surface treatment can be renewed at nominal cost as often as necessary.

Some objection to patented roads has developed from time to time on the part of municipal or state authorities. This seems to me unreasonable and unfair. Every man who has, by his intelligence or labor, discovered a better way of building a road, or of transmitting intelligence by electricity or other thing useful to mankind, is fairly entitled to protection, otherwise all countries would not have recognized it by establishing patent offices and granting patents, trade marks and copyrights.

Undoubtedly the best and most useful things we enjoy were originally issued under patent protection in whole or in part, and if we were to adopt the common practice of rejecting a thing because it is patented, very slow progress would be made in the arts and sciences. The protection furnished by patent rights is the incentive necessary to encourage inventive effort.

HAROLD PARKER,
First Vice-President
Hassam Paving Co.,
Worcester, Mass.

Water Supply in Concrete Paving

On city streets the water supply (in concrete paving), is not a problem; but on country highways, where it is necessary either to haul or to pipe water a considerable distance, it is advisable to make a careful survey of the situation. In estimating the cost of water the amount required for keeping the pavement damp for a period of five days must not be neglected, and as this is an indefinite quantity dependent upon weather conditions, only an approximate cost can be suggested. On the Wayne county (Mich.) work the water for each road is costing $3.50 per day, plus oil and gasoline required in operating the engine pump; $3.50 is the wage for a man looking after the pumping. Water for the Mukwanago road in Milwaukee cost 1¼ cts. per cu. yd. of pavement. In this case the water is purchased from the city of Milwaukee or its suburbs. In both cases the contractor's and builder's equipment must include the necessary engines, pumps, piping, etc. The cost of hauling water for use in constructing country highways of concrete is often an item worthy of careful consideration. The method of supplying water by piping is considered by the majority of contractors as most economical.—From a recent paper by C. W. Boynton on concrete paving.

Concrete has been unanimously selected as the material to be used on the proposed highway running from the Twin Cities to Duluth. This is especially gratifying for the reason that in initial cost, the concrete highway is considerably higher than either macadam or gravel and clay in the district, but the desirability of the concrete highway, together with its extremely low maintenance cost, decided the tax payers in favor of the best modern pavement.

Problem Solved in Casting Bridge Balusters Successfully

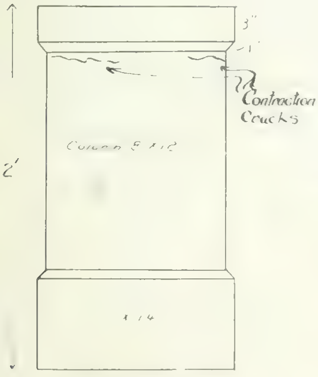
A suggestion as to making use of your magazine in your everyday work—calling on the Information and Consultation Department for real service.

The publication of the following correspondence in which the name of the firm of engineers and contractors in the East which made the inquiry, is omitted, serves a double purpose. It will doubtless be an acceptable bit of practical information for numerous readers who have encountered or will encounter similar problems. In addition it serves to emphasize the special work which Concrete-Cement Age is carrying out all the time. In this light it may serve to encourage readers to submit little special problems of this kind to their magazine. It usually happens that the Editors of Concrete-Cement Age can refer such inquiries to the MEN WHO KNOW and who usually are GLAD TO TELL. The first letter was accompanied by a return envelope stamped for special delivery; the second letter from one of the Editors went out by return mail. The third letter from the original inquirer tells the result.

The Problem

May 16, 1913.

We have encountered a difficulty in making concrete balusters, to be used in a bridge railing. The baluster, the shape of which is shown by the accompanying sketch, is composed of Portland cement, sharp sand and ½-in. pink granite in the proportion of 1:2:3. The wood forms are made in three parts, separating at the corners. The forms have to be removed in about 24 hrs., so that the surface can be washed to give a rough effect. Upon removal, cracks, as shown in the sketch, developed. Our opinion is that the upper 4" sets more quickly than the main column, which shrinks away from it.



[illegible]

We have tried wet and dry mixtures, cutting down cement, light and heavy tamping, but cannot eliminate these cracks.

We would greatly appreciate it if you could help us out, and we are enclosing an addressed envelope with special delivery stamp, as we are being held up on this contract.

The writer was a subscriber to *Concrete* for several years, and you may now place our firm on your list for Concrete-Cement Age.

The Suggestion

May 17, 1913.

Answering your letter of the 16th in regard to cracks developing in bridge balusters: Similar cracks are a very common occurrence in pouring columns in building construction, and are undoubtedly due to a settlement of the wet concrete on top. The 4-in. cap sets more rapidly as it is exposed to the air and arches on the ledge, the main shaft of the balustrade shrinking away from it.

The only remedy we can suggest for this is to cast the shaft up to the top offset from 8 hrs. to 10 hrs. before the cap is placed and then cast the cap. It might be well to stick some pieces of steel rods down into the shaft to help out on the bond.

We note that you say you have used drier mixtures. It seems there should be no cracks with drier mixtures. Using drier mixture for the shaft than for the top should help. Are you casting the balusters in place or do they have to be placed afterward?

This is the best advice we can give you now, and while this is the writer's opinion, we went over to see John McMichael, building superintendent for Bryant & Detwiler (Detroit), who is erecting a building near here, and who was one of the superintendents in charge of the Rocky River bridge, Cleveland, where they cast balusters, following very similar methods. Mr. McMichael confirms our opinion and states that there should be no difficulty whatever if you lay the concrete for the base and shaft, letting it stand from 8 hrs. to 10 hrs. before casting the cap.

The Result

June 3, 1913.

In connection with the manufacture of concrete balusters, we are pleased to state that we have been following the scheme of pouring, as suggested by you. This method has given the best of results, and no further cracks have developed.

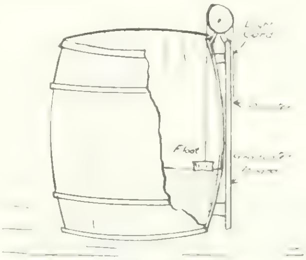
We wish to thank you again for your prompt and valuable advice, and assure you that if we can ever be of any assistance we will give it with pleasure.

Germany's cement trade in the first quarter of 1913 has been of a character very gratifying to investors. A remarkable increase in exports is reported. The value of cement shipped out of Germany in the first 3 months of 1913 is valued at 8,610,000 marks ($2,152,500) as compared with 6,030,000 marks ($1,507,500) in the corresponding period of 1912.

Imports of cement into Germany decreased from 1,210,000 marks ($302,500) in the first quarter of 1912 to 870,000 marks ($217,500) in 1913.

An Ingenious Water Gauge Is Readily Constructed

In handling concrete work it is very essential that the consistency of the mixed concrete be watched very carefully. The cement, sand, and aggregate going into a job are constants or known quantities, at least they should be. But the amount of water is very often left to the judgment of the man running the mixer; he puts in so many pails or lets the pipe run so long. On his part it usually amounts to a guess and admitted even that when a man runs a mixer for several years he can gauge this very accurately, yet it seems as though there should be used better and more accurate measuring methods to guard against carelessness or in the event of having to use green men behind the mixer.



[illegible] SHOWING [illegible]

The accompanying sketch shows an ingenious rig for measuring the amount of water to a batch. In this method an ordinary water barrel is placed near, preferably above the working platform of the mixer, with a large pipe leading down into the mixer drum. It is usually fed by a smaller pipe working under water pressure. A pulley is arranged on the top of this barrel and over this pulley is run a light cord. A float is attached to one end of the cord and to the other another light weight which holds the end of the cord down and which can be used as a pointer in indicating the water level in the barrel. As the barrel fills up the pointer on the outside moves downward. When it has reached a certain point the water can be shut off and for each batch of concrete a definite amount of water can be placed as indicated by the distance traversed by the pointer on the outside of the barrel. This distance can be arranged in any convenient units and in practice it will be found best to have this measured by definitely fixed points on the exterior of the barrel. This is a suggestion which should prove of value to concrete contractors.

Concrete work in the locks of the Panama Canal is nearly completed, the amount in place at the close of work June 7 being 4,461,597 cu. yds. This total is divided as follows: Gatun locks, 2,037,621 cu. yds.; Pedro Miguel locks, 921,179 cu. yds.; Miraflores locks, 1,502,797 cu. yds.

How-to-Do-It Information for Farm Work

This collection of "how-to-do-it" articles, describing five different works, is prepared from information and illustrations supplied by the Association of American Portland Cement Manufacturers.

How to Build Concrete Dipping Vats for Hogs and Sheep

The passing of the range, the breaking up of the western ranch into farms and orchards, has caused a decided change in the nation's method of producing meat. The resulting increased prices have made stock-raising profitable everywhere. This fact is particularly true of hogs. To grow bone and to put on flesh, swine must be healthy and must have sanitary surroundings.

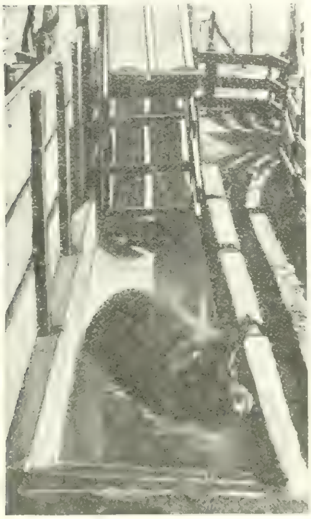


FIG. 1—HOW THE CONCRETE DIPPING VAT IS USED

Nothing retards the growth of a hog so much as lice. Years of experience have shown that the best remedy for destroying lice and fleas is dipping in chemical solutions. Dipping also keeps the skin of the animal in a healthy condition and thereby aids its growth. Because of cheapness in first cost and lasting qualities, most dipping vats are now built of concrete.

The best place to locate a dipping vat is close to a fence, near the water supply, and convenient for a chute leading from a small, well fenced lot or corral. At the narrow end of the chute, and in line with it, lay out the dipping tank (in accordance with the dimensions on the plan below) with the entering slide next to the chute. Make the excavation the same depth as the inside of the finished vat and of the same shape but 12″ wider. Dig the deep part of the hole first and then slope the earth for the "entrance-slide" and the "climb-out." Lay the outlet drain pipe with its end even with the surface of the finished concrete bottom.

The side walls only will require forms. If the banks stand firm, inside forms alone will be needed. Make these of old 1-in. lumber on 2-in. x 4-in. uprights. The full inside length of the tank is 15′, but the deep part is only 6′ 6″ long. The clear widths at the top and bottom are respectively 3′ and 1′ 6″. Since the concrete floor, as well as the side walls, is 6″ thick, set the side wall forms in place upon 6-in. concrete blocks, so that the floor may be built under them. Space the forms properly and crossbrace them firmly upon each other.

Mix the concrete 1 part Portland cement to 2 parts sand to 4 parts crushed rock or 1 part cement to 4 parts pit gravel. Lay the floor and inclines directly on the solid earth. The concrete for the sloping ends should be made only medium wet, so that it will tamp well and stay in position without the use of forms. In the concrete for the inclines, 2″ from the top, place strips of woven wire fencing to prevent possible cracks from heaving by the frost. As an aid to the animals in climbing out, embed in the concrete of the "climb-out" the turned-up ends of iron cleats, bent at right angles, similar to a capital "U". Old wagon tires, straightened out and cut in lengths not greater than 20 in. and turned up 4″ at either end, will do. Leave 1-in. clearance between the flat surface of the cleats and the concrete and space the cleats 8″ apart. Fill the 6-in. space between the earth and side forms with concrete, mushy wet. In placing this concrete, be sure that it strikes the wooden form instead of the earthen side, as dirt in the concrete may make a weak, leaky wall. Carry the walls 6″ above the surrounding ground (to prevent surface water from running into the vat) and in each corner, 2″ below the surface, lay steel rods. The entrance slope should be smooth, to slide the animals into the vat without skinning them up; therefore, finish its surface with a wooden float and a steel trowel.

At the leaving end of the vat there are often built two "dripping pens," with their division fence on a line with the center line of the vat, so that the gate at the dripping vat, hung to this fence, may close either pen, when it is full, and allow the animals from the vat to pass into the empty pen. The floor of these pens is built the same as a sidewalk or feeding floor, except that the surface is grooved and sloped so that the dip running off the animals will drain back into the vat.

For a dipping vat of the dimensions shown, there will be required 3 cu. yds. of crushed rock, 1½ cu. yds. of sand and 5 bbls. of Portland cement.

If a longer tank is wanted, for each 3-ft. increase of length in the body of the tank there will be required ½ cu. yds. of crushed rock, ¼ cu. yds. of sand and 4 bags of cement.

When not in use, a concrete dipping vat needs no care other than providing it with a good cover or so enclosing it as to prevent accidents. It will not rot or rust out and will require no repairs. Such an improvement is a paying investment for every farmer.

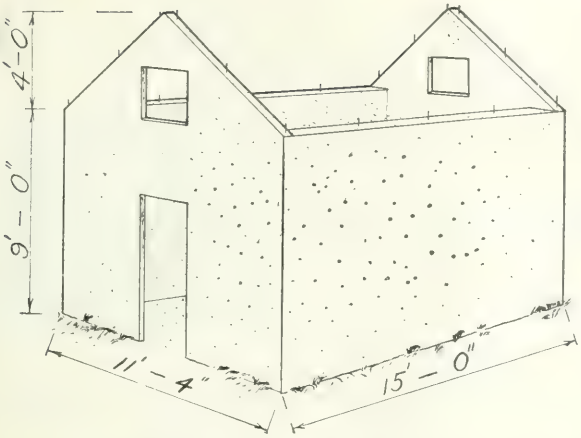
FIG. 2—SECTIONAL VIEW OF CONCRETE DIPPING VAT

Construction of Small Concrete Ice-Houses

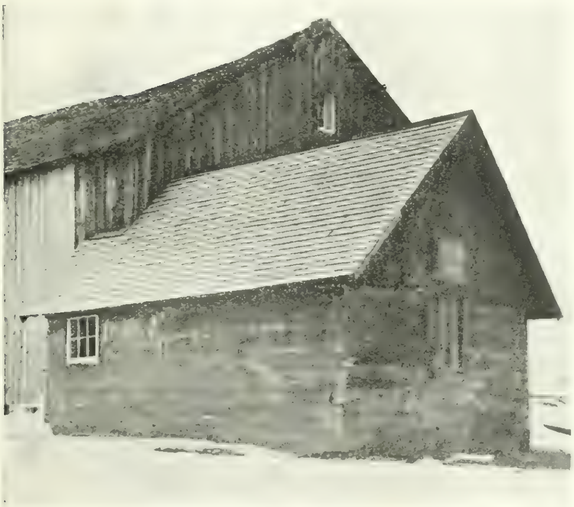
In the sweltering heat of summer many a country family longs for the comforts afforded by a home supply of ice. Too often summer passes without any preparation having been made for harvesting the winter ice crop. Now is the time to get ready for next summer by building an ice-house. For a private supply, many persons are using concrete ice-houses, since concrete is heat-resisting, is not rotted by the continual dampness from the ice and is ready every winter without repairs. Likewise a concrete building is fireproof, a quality especially valuable in the country.

Size of Building and Location.

With a concrete house, successful storage of ice depends only upon *careful packing*, *air-trapped drainage* at the floor line, and *well regulated ventilation* beneath the roof. Therefore, the ice-house must be located on a well drained site and, if possible, in the



Rot-Proof Ice-House of 20-Ton Capacity.



Concrete Ice House : Milk Room in Rear.

shade of other buildings or trees. It should be turned end to the south.

The size of the building is dependent on the needs of the family. Nearly any household will consume 100 lbs. every day, or 10 tons for the season. One cu. ft. of ice weighs 57 lbs. and a ton in the ice-house occupies about 40 cu. ft. If the ice is of poor quality, meltage frequently amounts to ⅓ the quantity harvested; therefore, it is wise to build a house of a capacity twice the calculated needs. For a farm with a small dairy, a sufficient supply can be stored in a building 10' x 14' (inside measurements) x 9' to the eaves and 13' to the comb of the roof. With an allowance of 1' on all sides of the ice for a packing of sawdust, the capacity of this structure is 20 tons.

Method of Construction

Either concrete block or solid concrete may be used for the walls. Dig the foundation trenches 10" wide and 2' 6" deep. To remove water from the melting ice, lay a string of 4-in. drain tile from a point outside the building and ending at the service door, so that the top of the last pipe, a sewer "goose neck," will be at floor line 4" above natural ground level. Fill the foundation trenches with concrete proportioned 1:2½:5. Above ground level the walls may be made of block (laid in a 1:2 cement sand mortar) or of solid concrete. For the solid wall mix the concrete 1 bag of Portland cement to 2 cu. ft. of sand to 4 cu. ft. of crushed rock, or 1 part cement to 4 parts bank-run gravel. Use movable forms, 3' high and extending around the entire building, to hold the mushy wet concrete until it sets. The day after they are filled, the forms may be loosened, moved up and filled again. During the placing of the concrete, reinforce the walls, 3" from the outside, with woven wire fencing or with ⅜-in. rods spaced 18" apart and running in both directions. Stagger the rods by placing half of them 3" from the inside surface of the walls. Embed two rods or an old wagon tire in the concrete 2" above all door openings. During the construction set a service door frame (2' 6" x 6' 6") between the forms at one end of the building. Likewise, while pouring the concrete for the gable ends, make provision for small ventilation doors 2' 6" square.

A wooden roof, while not durable like one of concrete, is more easily built. To hold the plates on the top of the side and the gable walls, sink ½-in. bolts 8" long, heads down 6" into the concrete. Use 8-ft. rafters and cover the building with a water-tight roofing material.

Lay a 4-in. concrete floor upon the natural ground and give it a slope of ¼ in. to the foot in the direction of the drain at the service door. Place a trash strainer in the drain opening. The water in the "goose neck" sewer pipe will act as a seal and keep out the warm air of the drain.

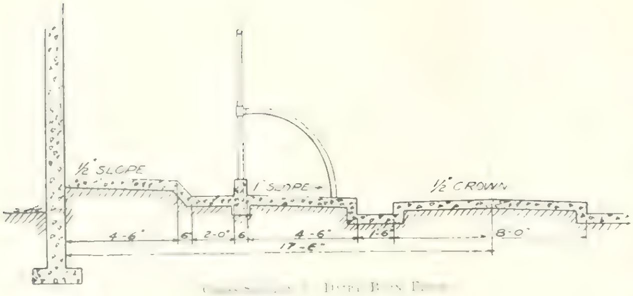
Hinge the small doors in the gables to outside and top of the frames so that they can remain slightly open at the bottom, yet shut out rain. The service door also swings outward. The frame is fitted with short removable sections of boards set in slots or grooves so as to hold the packing in place.

Storing and Removing Ice

In storing ice use a thickness of 12" of sawdust or 18" of marsh hay or straw over the floor and around the sides of the house. Set the ice on edge and pack it tightly together without any filler between the cakes. To prevent blocks from slipping, lay them in courses lengthwise in opposite directions in what masons call "headers and stretchers." When the house is full, cover the ice-pack with sawdust or hay, weighed down. Keep the service door closed while removing ice and take care that the pack is again well covered. See that the drain works properly and prevents water from standing on the floor.

Materials and Cost

For building this solid wall concrete ice-house, there will be required 27 bbls. of Portland cement, 8½ cu. yds. of sand, 17 cu. yds. of crushed rock and 74 pieces (250 lbs.) of ⅜-in. rods 9' long. If good pit gravel is at hand, haul 18 cu. yds: no sand will be required other than that in the gravel. The approximate total cost of these materials is $75. Such a structure will not rot out and will keep the ice with minimum shrinkage. And by means of ice, not only can more comfort be secured in hot weather, but also fruit, poultry and dairy products can be marketed at a greater profit



Cross-Section of Dairy Barn Floor

How to Lay Sanitary Floors in Dairy Barns

In the voluntary movement of farmers for *better milk at better prices,* the first step toward improvement is to make the barn more sanitary by laying concrete floors. The method is so simple that any man with care can do his own work. The cost is so small and the cash returns are so great that the floors soon pay for themselves in preventing the breeding of flies, in the saving of liquid manure, in the reduction of labor, and in the increased flow and improved quality of milk. The plan described below is for a barn in which the two rows of cows stand heels toward each other, with a driveway between. It is easily modified to the opposite arrangement. Likewise the method is adaptable to both old and new barns.

For average conditions lay out the stalls on 3-ft. 6-in. centers and 4′ 6″ in length from 6-in. manger wall to drop gutter. The manger is 2′ 6″ wide at the top and 2′ at the bottom, with one face sloping up to the feed-alley floor. The depth is 7″, measured from the stanchion setting, and 8″ from the alley floor. The feed alley is 4′ 6″ wide. The drop-gutter has a width of 18″. It is 8″ deep gauged from the stall floor, which is 2″ higher than the 8-ft. driveway. For establishing grade lines a carpenter's spirit level (or a water level) and a chalk line are very helpful.

To prevent possibility of the floor settling, remove all manure before grading the surface of the earthen floor. Carefully tamp back the dirt around water pipes and the drains which carry waste water and liquid manure to the watertight concrete manure pit. Do all filling as long as possible before building the concrete floor. As a foundation for the stall floors proper, place a 6-in. thickness of coarse broken stone or screened gravel to keep the floor from direct contact with the ground. Since the stall floors are of prime importance, it is well to make them first. During this operation the unpaved driveway and alleys can be used as working space. Then finish, in order named, the feed alleys, the driveways, the mangers and lastly the gutters.

For the plan given, 5′ 6″ from the center line of the driveway stake on edge (and to line and grade) a plank 2″ by 12″, to serve as a form for the stall floor at the gutter. Likewise set a similar board, 5′ distant, to mold the 6-in. manger wall and stanchion setting. Bear in mind that the stall floor has a slope of 1″ toward the gutter and that the stanchion setting rises 7″ above the stall floor. Drainage for gutters and mangers will be provided by sloping their concrete bottoms.

Proportion the concrete 1 bag of Portland cement to 2½ cu. ft. of sand and 5 cu. ft. of crushed rock, or 1 bag of cement to 5 cu. ft. of clean pit gravel. At one operation lay the full 5-in. thickness of the stall floor and finish three stalls the same as one section of sidewalk. No surfacing mortar is needed. For setting patented stall divisions, follow the manufacturer's directions; for homemade divisions, make mortises by tamping the concrete around greased tapering wooden cores, which are withdrawn as soon as the concrete stiffens. A wooden float is best for finishing the floor. A steel trowel yields a surface entirely too smooth, and such a finish should always be roughened by brushing with a stable broom.

While the concrete of the three stalls is still soft, mold the stanchion setting (6″ thick) upon it. As forms use the projecting 7-in. height of the 2-in. x 12-in. piece already in place and two boards 1″ by 6″ toe-nailed together so as to provide another 7-in. height and a bearing plate to rest on the green concrete. These forms may be made dish-shaped for swinging stanchions. Fill the forms with mushy wet concrete, trowel the surface, round the corners, and set the stanchion holders. Repeat the operation until all stall floors are completed. The feed alleys and driveway are easily built: they are merely rough-finished sidewalks. Place the waste-water outlets in the mangers at intervals of 28′ and give the bottom a slope of 1″ toward each outlet for a distance of 14′ on each side of it. The drop gutters may be drained in like manner or can be sloped slightly in one direction for their full length. For ease in cleaning, round all angles and corners [illegible] at the bottom of the drop gutters) by applying a 1:2 cement-sand mortar immediately after removing the forms.

With the proportions and thicknesses given above, 4 bags (1 barrel) of cement, 10 cu. ft. of sand and 20 cu. ft. of crushed rock will lay 45 to 50 sq. ft. of floor. The usual cost of this material is about $2.50. The floor soon pays for itself many times over.

Concrete Hog House Floor with Wallow [illegible]

Sanitary Floors for Poultry, Sheep and Hog Houses

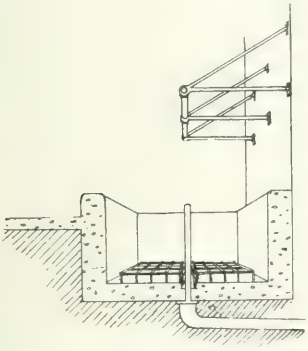
Poultrymen and sheep and hog breeders are finding concrete a very satisfactory floor material for their buildings. Concrete floors have no cracks in which lice, ticks and similar vermin can breed and are likewise proof against the attacks of rats and other destructive animals. Moreover, concrete floors do not harbor disease germs and can easily be cleaned and disinfected. Properly bulit and cared for, they are not damp and do not cause rheumatism.

The first step in building a floor is to remove all manure and other foreign matter and then to grade the surface of the ground. If needed, lay all water pipes and the drains necessary for keeping the ground dry, for carrying off waste water and for conducting the liquids to the manure pit. Such earth filling as may be necessary must be dampened and thoroughly tamped. This work should be done as long as possible before building the floor. Keep the concrete from direct contact with the earth by covering the entire surface of the leveled-off ground with 6 in. to 8 in. of coarse crushed rock or screened gravel.

For grading the surface of the floors use a carpenter's spirit level (or water level) and a chalk line. A 4-in. thickness of concrete is sufficient. Slope the floor ⅛″ per foot in such direction that the rain or scrub water will cause the least inconvenience. For poultry houses this will usually be toward the door; for sheep sheds and hog houses, away from the animal's bed and in the direction of the gutters.

The usual proportions of concrete for such floors are 1 cu. ft. of Portland cement to 2½ cu. ft. of sand to 5 cu. ft. of crushed rock or screened gravel, or 1 part of cement to 5 parts of bank-run gravel. These materials are measured on the basis that 1 bag of cement (loose) equals 1 cu. ft. Mix them thoroughly on a tight wooden platform (never on the ground) and use enough water to make the concrete "quaky."

Lay the floor in a manner similar to sidewalk construction. If the sand and rock are first-class in quality, no finishing mortar is required. Such a mortar is generally mixed 1 part cement to 2 parts sand and is applied (1" in thickness) to the 3-in. concrete base before the latter has begun to set. To provide good footing for animals, the floor should be finished merely with a wooden float. A steel-trowel finish is entirely too smooth and, if made, should be roughened with a stable broom. Should removable wooden or gas-pipe pen-divisions be used, make mortises for them in the floor at the proper points by inserting short lengths of gas-pipe or drain tile, or by tamping the concrete around tapering greased wooden cores, which must be withdrawn as soon as the concrete has stiffened.



Details of Concrete Cooling Vat

How to Build a Concrete Cooling Vat

A concrete cooling vat, fed from a spring or other water supply by means of pipes can be used to excellent advantage as a place for butter, milk and other farm products when ice is not available. The size may vary, of course, according to needs, but for a farm with a small dairy, sufficient space is to be had in a tank 4' 2" by 7' 2" in the clear, by 23" deep and with 5-in. walls and bottom. This vat will hold eight regulation shipping cans spaced 6" apart.

In a corner of the milk house dig the pit for the vat 5' wide, 8' long and 22" deep. If the water is to be led and removed by iron pipes, these should be laid at once with their ends provided with screw or sleeve couplings, 5" above the earth bottom of the pit.

[illegible] tank 4' 2" wide by 7' 2" long [illegible] measurements and 23" deep. Mix the concrete mushy wet of 1 bag of Portland cement, 2 cu. ft. of sand and 4 cu. ft. of screened gravel or crushed rock, or 1 part cement to 4 parts pit gravel. Place corks in the ends of the pipes and lay the 5-in. bottom with a strip of woven wire fencing in the concrete within 2" of the top. Quickly finish the bottom smooth with a wooden float and a steel trowel and at once set the box form in the pit so as to leave a space of 5" on all sides. Fill this space with concrete. Around the corners of the tank, near the top and the bottom, embed iron rods. Bring the outside walls to full height above floor level by using a width of board along the side and end. Round the edges and finish the top of the walls with a trowel.

When the tank is two days old, carefully remove the forms. Rub down the walls with a soft brick and paint them with a creamy mixture of cement and water. Five days later the vat may be used. In the coupling of the outlet pipe, place a section of over-flow pipe 19" long, which will draw off the warm water at the top of the tank. The overflow pipe should be at least ½" greater in diameter than the inlet pipe so as to remove all danger of flooding the milk and the dairy house. Make a grating of 1-in. slats or gas pipe to place on the bottom of the vat to provide a circulation of cool water under the milk cans. As an aid in lifting the cans, fix a hand-rail at a convenient height above the tank. For this vat there will be required 1½ yds. of crushed rock or screened gravel, ¾ yd. of sand and 10 bags of cement at a total cost of about $6. Two men can build it in one day

Hope, Ark., is optimistically named and her citizens are an ingenious lot. The town wanted concrete sidewalks, being progressive and modern, but funds were a trifle low. The difficulty was met by selling advertising space in the sidewalks. Announcements of a permanent variety were made either by forming letters in the top coat before it set, or by metal letters embedded in the concrete. A portion of the display space was reserved by the town and in this was printed a history of the community, names of officials and so on. This looks like a return to cuneiform inscriptions and the tufa school of literature—but the point is, the town got the sidewalks.

[illegible]

Concrete Organizations, Officials and Conventions

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Building, Washington, D. C. Meets as part of American Road Congress, Detroit, Sept. 30-Oct. 6.

American Road Builders' Association, Secretary, E. L. Powers, 150 Nassau St., N. Y. C. Convention and Exhibition, First Regiment Armory, Philadelphia, Dec. 9-12, 1913.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Building, Philadelphia, Pa.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy.-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill. CHICAGO Show, Coliseum, February 12-21, 1914.

Iowa Association of Cement Users, Henry H. Dean, Glenwood, Ia., Secretary.

National Association of Cement Users, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa. Convention, Chicago, Feb. 16-20, 1914.

Nebraska Cement Users' Association, Secy.-Treas., Frank Whipperman, Omaha, Neb. Convention Feb. 2-4 and Show Jan. 30 to Feb. 4, 1914, Omaha.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Bldg., Minneapolis, Minn.

Plans Being Made Well In Advance for Chicago Show

The Cement Products Exhibition Co. announces having sent out to exhibitors detailed information covering the next National Cement Show, which will be held in Chicago in the Coliseum, Feb. 12-21, 1914. This mailing of diagrams, rules and regulations and application blanks so early in the season is a new departure which it is believed will afford the management more time for working out the details of equipping, installing and advertising the exhibition. tion.

This year the first drawing for spaces will be held Tuesday, July 29, and all applications to participate in this drawing must be on file in the offices of the Exhibition Company not later than noon, Tuesday, July 22.

The coming show will be conducted on a more elaborate scale than any of the previous expositions and more time will be required for its preparation.

There will be but one show next winter and Chicago has been chosen because of its convenient location and because of its accessibility from all points within a large territory noted for its activity in concrete construction. This one show [illegible] held in the Coliseum and the big New [illegible]

Garden. This is possible because of the fact that there is to be but one show and the management will be able to devote its entire time and energy to bringing out a big attendance of contractors, cement products manufacturers, architects and engineers.

An elaborate scheme of decoration will be installed which will bring out the decorative possibilities of concrete to a more marked degree than in previous schemes of decoration.

The time chosen—Feb. 12-21—is most opportune because at that period of the year dealers, contractors, engineers and manufacturers have the most time to consider the purchase of equipment and are ready to receive estimates on their requirements.

The arrangement of spaces has been somewhat changed. The space units have been increased in size and space rates have been made considerably lower. This was planned especially to afford manufacturers of large machinery ample room in which to make their displays. The arrangement is such that all parts of the Coliseum and the Annex will be easily accessible. The omission of partitions, which in previous shows cut off to some extent the view of displays, and the opening of aisles, especially in the Annex, will give every visitor to the show an opportunity to inspect all of the exhibits. A new space numbering system will be used so that the visitors can more readily find exhibitors for whom they are looking.

The show will be two days longer than heretofore and no doubt the two additional days will bring out a considerable increase in attendance. These additional days were provided so that out-of-town visitors, attending the numerous conventions, which will be held in Chicago while the show is on, will have ample time to attend both the conventions and the exhibition.

Cement shows in Chicago have been uniformly successful, both from the point of view of the management and of the individual exhibitors. In the promotion of the 1914 show the management announces that it has been guided solely by the wishes of the majority of the previous exhibitors.

American Road Builders Meet In Philadelphia In December

The American Road Builders' Association will hold its tenth annual convention in Philadelphia, Dec. 9 to 12, meetings and exhibits to be in the First Regiment Armory, Broad and Callowhill Sts.

The annual meeting brings together leading men in the United States identified with road building and street paving who meet for the purpose of discussing the problems in which they are vitally concerned. Plans are now being laid by the officials of the Association to make the Philadelphia meeting the largest and most important gathering of the kind ever held in the United States.

As usual, there will be in connection an exposition of road and paving machinery, material, and so on, under the auspices of the Association; this is a most important part of the meeting and is invariably participated in by leading manufacturers of the industry. The main floor of the Armory will be devoted to the exhibition feature, this floor being strong enough to hold the largest and heaviest machinery.

The American Road Builders' Association was formed in 1902. Among its members are leading road and paving experts, highway officials, engineers and contractors in the United States. Samuel Hill, Seattle, Wn., is president. He is also life president of the Washington State Good Roads Association, and is identified with other Good Roads organizations. The other general officers of the Association are as follows: First vice-president, Harold Parker, former chairman Massachusetts Highway Commission; second vice-president, W. A. McLean, Provincial engineer of highways of Ontario, Canada; third vice-president, George W. Tillson, consulting engineer, Borough of Brooklyn; secretary, E. L. Powers, editor *Good Roads;* treasurer, W. W. Crosby, consulting engineer. The Directors of the Association include Gen. T. Coleman duPont; Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment, New York City; William H. Connell, chief of the Bureau of Highways and Street Cleaning of Philadelphia; R. A. Mesker, state highway engineer of New Jersey; A. W. Dean, chief engineer Massachusetts Highway Commission; Austin B. Fletcher, state highway engineer of California, and A. H. Blanchard, professor of highway engineering, Columbia University.

Third International Road Con- Being Held In London

The International Road Congress, which is being held in London, England, as this journal goes to press, will bring together leading men from practically every country identified with highway construction and maintenance. This is the third Congress of the kind to be held, and is the first to be held in an English-speaking country. The first Congress was held in Paris, France, and the second in Brussels, Belgium. These Congresses are held every three years.

Papers will be presented from accepted authorities in each country. No less than 25 of these papers covering the various phrases of road building construction, repair and maintenance, will be presented by American authors.

The City of London and the British Government prepared elaborate entertainments for the delegates to the Congress. Excursions were arranged for the week previous to the Congress, during the week of the Congress, and the week following. Among the receptions were to be one at the Guildhall at the invitation of the Lord Mayor and Corporation of the City of London on the evening of June 23, also one at Albert Hall by the Institution of Civil Engineers on the evening of June 25, and one by the Royal Automobile Club on the evening of June 26. At Windsor Castle the members of the Congress were to be entertained by King George June 26. The president, council and members of the Surveyors' Institution were to give a Garden Party at the Royal Botanical Gardens June 27.

Among the members of the American Road Builders' association appointed to go as delegates are the following: Samuel Hill, president and official delegate of the American Road Builders' Association; O. E. Weller, chairman Maryland State Roads Commission, Baltimore, Md.; Henry G. Shirley, chief engineer Maryland State Roads Commission, Baltimore, Md.; C. A. Kenyon, president Indiana Good Roads Association, Indianapolis, Ind.; H. S. Carpenter, superintendent of highways, Regina, Sask.; W. A. McLean, provincial engineer of highways, Toronto, Ont.; Nelson P. Lewis, chief engineer, board of estimate and apportionment, New York City; George W. Tillson, consulting engineer, Borough of Brooklyn, N. Y.; W. W. Crosby, consulting engineer, Baltimore; Clifford Richardson, consulting engineer, N. Y. C.; Henry Welles Durham, chief engineer of highways, Borough of Manhattan, N. Y. C.; Edwin H. Thomes, assistant engineer, Bureau of Highways, Borough of Queens, N. Y. C.; Daniel B. Goodsell, assistant engineer, Department of Public Works, N. Y. C.; Arthur H. Blanchard, professor highway engineering, Columbia University, N. Y. C.; William D. Sohier, chairman, Massachusetts Highway Commission, Boston, Mass.; A. N. Johnson, state highway engineer, Springfield, Ill.; Joseph Hyde Pratt, state geologist, Chapel Hill, N. C.; George W. Cooley, state highway engineer, St. Paul, Minn.; A. B. Fletcher, State Highway Engineer of California, Sacramento, and E. L. Powers, editor *Good Roads*, New York.

Mid-West Show and Convention of Nebraska Cement Users

The board of directors of the Nebraska Cement Users' Association met in Omaha June 9 and set the time of the eighth Mid-West Cement Show as Jan. 30 to Feb. 4, 1914. This will give a five-day show.

Dates for the Ninth Annual Convention of the Nebraska Cement Users' Association were set for Feb. 2, 3 and 4. President Peter Palmer and Secretary Frank Whipperman anticipate a much larger show than was held last year.

The large Omaha auditorium will be re-platted, and the booths arranged in a more novel and attractive manner. Crop conditions over the entire Middle West are excellent and everybody is looking for a big year. The Association is getting into the game a little earlier than usual in order that greater publicity may be given among the cement users and concrete workers, and is going after memberships within a radius of 500 miles from Omaha.

NEW BOOKS

Engineering Directory, 1913. Twentieth annual edition; 1,540 pp., 4"x 6¾", leather bound. Crawford Publishing Co., Chicago; price $5.00.

The 20th annual edition of the Engineering Directory is an improvement over any previous edition.

The aim of the publishers of the Engineering Directory is to keep up with the times and furnish a volume which will be of real value in the manufacturer's selling campaign, and as a reference book and purchasing guide for the dealer. The section devoted to the products of manufacturers contains approximately 4,000 classifications. The 1913 edition contains:

1. Jobbers and Dealers in Mill, Steam, Mine, Heating and Lighting Supplies, Tools and Machinery in the United States. 2. Jobbers of Plumbing, Steam and Gas Fitting Supplies in the United States. 3. Dealers in Plumbing, Steam and Mill Supplies in Canada. 4. Wholesale Dealers in Hardware in the United States and Canada. 5. Manufacturers' Agents, representing Manufacturers of Mill, Steam, Mine, Plumbing and Heating Supplies. 6. Alphabetical List of Manufacturers of Plumbing, Heating, Lighting, Mill, Steam and Mine Supplies in the United States. 7. Classified Directory of Manufacturers of Plumbing, Heating, Lighting, Steam and Mine Supplies in the United States. 8. Purchasing Agents of the Principal Railways in the United States, Canada and Mexico. 9. Leading Architects in the United States. 10. Gas Companies in the United States. 11. Waterworks Companies in the United States. 12. Cement Mills in the United States. 13. Trade Associations and their Officers, Declaration of Principles and list of members of the American Supply & Machinery Manufacturers' Association. 14. Cross-index to manufactured articles classified in the Directory.

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The Production of Excessive Hydrogen Sulphide in Sewage Disposal Plants and Consequent Disintegration of the Concrete. By William M. Barr and R. E. Buchanan, Ames, Ia. This is Bull. No. 26 of the Engrg. Exp. Sta. of the Iowa State College of Agriculture and Mechanic Arts. 8¾"x5¾", paper bound, 16 pp., illus.

When sewage decomposes more or less hydrogen sulphide gas is produced and all experience indicates that hydrogen sulphide has more or less effect upon concrete surfaces. This bulletin reviews carefully the existing data on this subject and describes experiments carried on investigating the essential feature of the problem.

The sulphide is usually produced in two ways: (1) By the bacterial decomposition of sulphur containing proteins and related compounds and (2) the reduction of sulphates which are contained in unusual amounts in the water supply used. Of the two the second seems to be the more important.

The hydrogen sulphide which escapes as gas from the sewage, is to some extent dissolved in the moisture on the underside of the concrete roof and walls. Here it is oxidized to sulphuric acid partly by atmospheric oxidatiion and partly by bacterial action. The sulphuric acid acts upon the calcium compounds in the concrete, forming calcium sulphate and breaking down the concrete. An excess of free sulphur is often deposited which the oxidizing agencies have not converted into sulphate. The exact species of the organisms responsible for the conversion of hydrogen sulphide into sulphuric acid have not been determined. That bacteria in mixed cultures may bring about this change has been demonstrated, however.

Tables of Equivalents of Metric Weights and Measures. Bureau of Standards, Washington, D. C. 11½"x 9", paper bound, 46 pp., illust.

This is an exceedingly valuable and well-prepared table of metric equivalents and will be found invaluable to anybody in need of such a conversion table. The book is introduced by a general summary presenting the fundamental equivalents and this is followed by complete tables covering length, area, volume capacities and masses. A chapter is included covering the legal status of the metric system in the United States.

This larger book is accompanied by a smaller 16-page bulletin which describes the essential feature of the metric system and explains on what the system is based. This bulletin was prepared as an answer to some of the more simple questions addressed to the Bureau of Standards in regard to the metric system.

The Swiss Chalet Book. William S. B. Dana. 7½ x 10. Price $2.50. 150 pp., illust., cloth bound. The Wm. T. Comstock Co., 23 Warren St., N. Y. C.

This is a new book for the architect on an interesting subject which it covers in great detail.

The Concrete House and Its Construction. Maurice M. Sloan. 9½ x 6, 224 pp., cloth bound, illust. Price $1.00. The Association of American Portland Cement Manufacturers, Philadelphia, Pa.

This is a book of popular appeal with practical value. It goes into all the uses of concrete in the construction of dwellings. It presents detailed descriptions of the methods of construction and takes up the processes which are involved in architectural treatment. It is a book for the architect, yet has its matter so arranged and presented as to be full of suggestion for the layman who may be considering the use of concrete for his home.

Ada county, Idaho, in 1912, under direction of Arthur E. Fox, consulting engineer, Boise, laid three miles of 2-course concrete road extending from the city limits of Boise northwesterly along the line of the Boise Interurban railway. After preparing a sub-grade in the prescribed manner the first course was laid, consisting of a 5-in. layer of concrete, mixed in the ratio of 1 part cement, 3½ parts sand and 7 parts gravel. The second course laid immediately after the first, consisted of a 1½-in. layer of concrete, made up of 1 part cement, 1½ parts sand and 3 parts of crushed rock, the rock having a maximum of ¾-in. diameter. The second course, constituting the wearing surface, was carefully floated to make it uniformly smooth. Finally, before the surface became dry it was covered by a ½-in. layer of sand and kept moist for a few days. This road is 20' and 24' in width. In addition to this, a 1,800-ft. concrete flume was built to Boise river to care for a troublesome deposit of sand which in times of freshets would bank up against the road. The flume cuts the road at right angles, passing under it through a concrete culvert. The side drainage consists of a 4-ft. canal on one side and a small channel on the opposite side, which at quarter-mile intervals drains through a culvert to the main canal.

The MacArthur Concrete Pile and Foundation Co., N. Y. C., has been awarded the contract for placing the foundation of the new 12-story arcade building to be erected at New and Beaver Sts., N. Y. C. This foundation will be composed of about 150 steel-concrete piles. The method of placing the piles is as follows: A 12-in. steel pipe is driven to rock, the soil inside of the pipe blown out by compressed air, and the cavity filled with concrete and reinforced with 2-in. steel rods. Rouse & Goldstone are the architects, and Robert E. Moss, cons. engr. for this building.

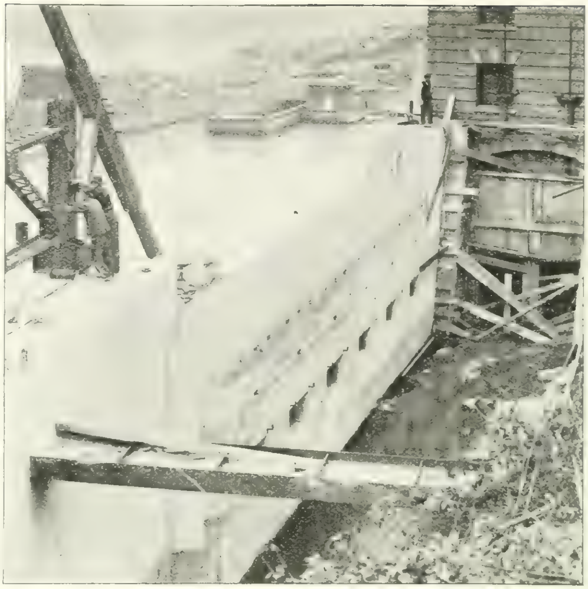
In building an oil pipe line from the Midway oil fields in California to tidewater at San Pedro, 700,000 ton-miles were covered in a hauling contract performed by a fleet of 18 White motor trucks. These supplanted 500 mules, crossed 40 miles of desert sand with practically every load, climbed altitudes as high as 8,500' and ran 9 miles of each trip on river bottom. These difficulties were overcome by the motor fleet of the Auto Delivery Co., San Francisco and Los Angeles, when that company accepted a contract to haul 35,000 tons of material through the wilderness.

Siphon Spillways to Control Water Surface of Reservoirs

BY WM. RUSSELL DAVIS*

The siphon principle is a very old one and has been put to practical use in many ways. Its use for the automatic regulation of the water surface of canals and reservoirs is, however, quite new. A few siphons have been built in Europe but the only ones which have been built in this country are those constructed according to designs by George F. Stickney, Albany, N. Y., who controls a patent on that form of automatic siphon which is described in this article.

The first installation was completed at Whitehall, N. Y., as a part of the N. Y. State barge canal system in 1910. Fig. 1 shows an upstream view of the Whitehall installation under construction and almost immediately before the cofferdams were removed. This installation has been in actual service for over 2½ years and has given excellent satisfaction. A battery of four siphons was subsequently built at Smith's Basin, N. Y., a single siphon at Fort Edward, N. Y., and eight installations of single siphons on the Glens Falls feeder which forms a part of the N. Y. state canal system. Other siphons are now under construction.



[illegible] 1—Showing the Upstream Spillway at Whitehall, N. Y., Under Construction
In this view are shown [illegible]

Figs. 2 to 6 inclusive show the details of the battery of six siphons at Whitehall, N. Y. The throat of each is 6" high and 8.6' long. The head varies with the height of the lower pool and averages about 15½ ft. The upper pool has a very large area and rises comparatively slowly. A rise of about 3 ins. above the lower edge of throat is sufficient to start siphonic action which is broken when the water falls to the low level.

Recent tests on one of the siphons on the Glens Falls feeder showed by repeated trials that it will invariably start and stop automatically as designed and is entirely satisfactory. The particular siphon tested will respond to a variation of water surface of only 1½" while the height of the throat of the siphon is 1'.

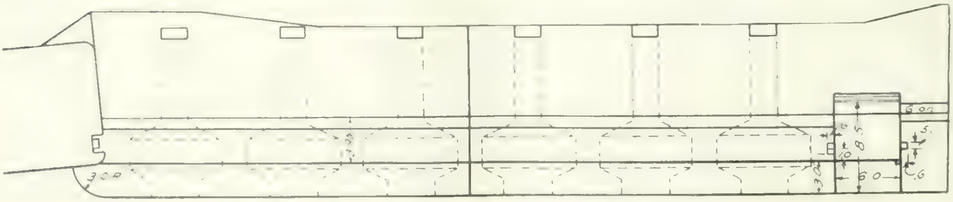
All of the Stickney siphons heretofore built and in course of construction are built into the body of a concrete dam [illegible]

Siphonic Action Automatic

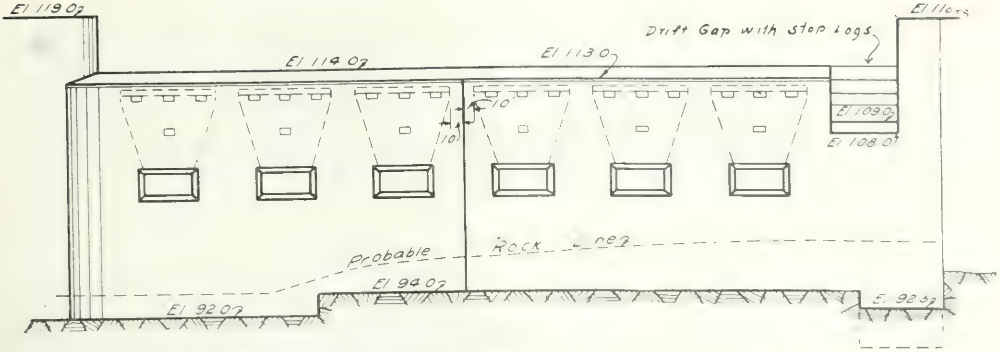
[illegible] typical concrete siphon designed similarly to those built at Whitehall. The action is entirely automatic. Unless it is desired to pass a small amount of water through the siphon at all times, the lower edge of the crown, or throat, is placed at the low-water stage. When the water is at the low stage none of it will flow through the siphon. At this stage air is freely admitted to the crown of the siphon through the air-vents. As the water above the dam rises it spills over the lower edge of the throat in small volume and soon closes the air-vents. By the time the water reaches the top of the throat true siphonic action will take place, although under certain conditions the siphon will start before the water has risen to the high stage or top of throat. If now the capacity of the siphons is greater than the excess flow which is to be wasted, the water surface will gradually fall until the air-vents are uncovered sufficiently to break the siphonic action. This occurs when the low-water stage is approximately reached.

The siphon may discharge under the tail water as shown by Fig. 7 or may, where conditions require, discharge above the tail water. The action in the two cases is different in some respects but agrees in this that it is equally automatic, reliable and efficient. When the outlet is submerged, the volume of water discharged depends upon the difference in elevation between the surface of the pool above the dam and the surface below. When the outlet is not submerged it depends upon the distance from surface of upper pool to center of outlet.

As an example of the efficiency of a siphon compared with an overflow waste weir designed for the same conditions the Smith's Basin spillway is cited. The necessarily fixed at 1'. An overflow spillway would have been 200' long between abutments and the discharge would have been 3½ cu. ft. per sec. per lin. ft. of crest. The cost would have been approximately $15,000. The siphon spillway built will dispose of the same amount of water with a fluctuation of less than 1 ft. Its length between abutments is only 57' of which 20' is used for a drift-gap. The cost was approximately one-half of that for an overflow



[illegible] Siphon Spillway at Whitehall



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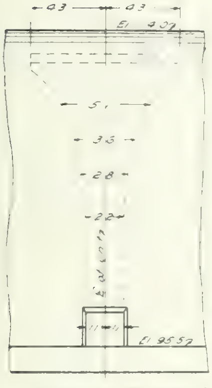


DOWN-STREAM ELEVATION
Fig 4

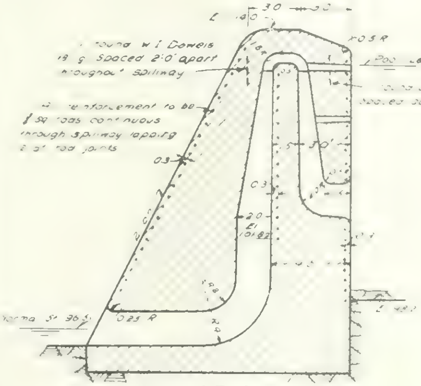


Fig. 5 SECTION

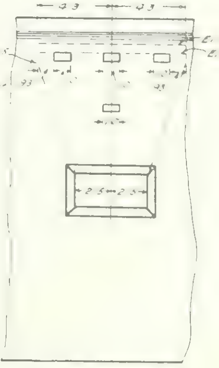


Fig 6 UP STREAM ELEVATION

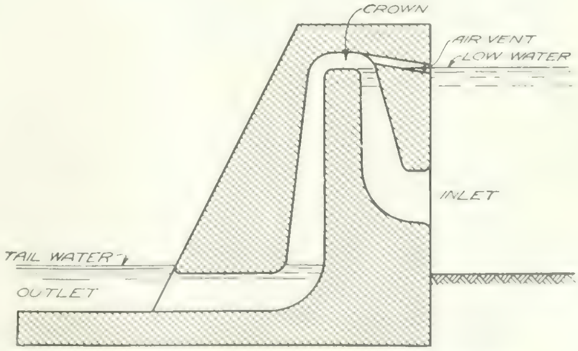
[illegible]

spillway, thus showing a saving of approximately $7,500.

Each special siphon problem must be given careful consideration on its own merits as the design of any siphon must be made to conform precisely to the requirements of each individual case.

High Velocity Siphons

The action of the high velocity siphon is not well understood by most American engineers. No mention of it is made in text-books on hydraulics. Whatever is said on this subject of siphons in the text-books relates to low velocity pipe lines where siphons are generally objectionable on account of the accumulation of air at the top in sufficient quantities to destroy the efficiency of the line. No such trouble is ever experienced with the automatic siphon for the reason that as soon as the water reaches the point where siphonic action begins the velocity of flow is so great as to carry all air out of the siphon. Careful experiments have shown that any such siphon will successfully carry away a very large amount of air at atmospheric pressure purposely admitted to the throat through air pipes provided for the purpose of demonstrating the powerful suction which exists in the throat of a high velocity siphon.



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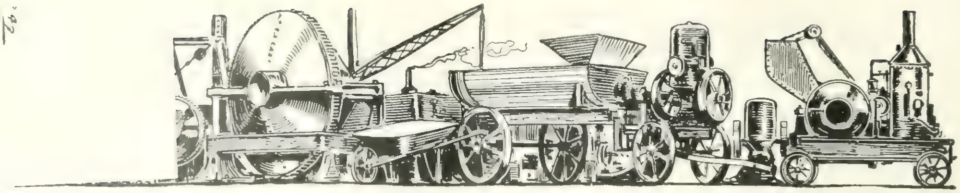


New Equipment, Methods and Materials

> In this department the EDITORS endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in this paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

Atlas Concrete Pipe Machine

There is a tendency toward a heavier, more powerful type of machinery in concrete products manufacture and one of the new machinery productions which bears out this tendency is the Atlas pipe machine, made by the Atlas Concrete Pipe Machinery Co., Salt Lake City. In connection with this machine the slogan of the manufacturers is significant: "Costs more to build, costs less to run and does more while it runs."

There are 12 special points to which the manufacturer directs attention, and these are given here practically as stated by the company:

The machine weighs 30 tons. It has four rotating flexible steel tampers which strike very powerful blows and produce uniform density from the bell to the spigot end. It is possible to make pipes of extremely wet mixture so that the troweled interior has an impermeable coating that is smooth and true. The "web" on the exterior wall of the pipe is a guarantee of impermeability. The core which does the troweling on the inside rotates independently of the tampers and table and can be operated indefinitely. The core is drawn downward in the same direction as the tamper blow, thus tending to increase the density. Two levers above the head and two at the feet of the operator provide for the easy manipulation of the entire machine. Tables are shifted by pressing a lever with the foot. Tables automatically reduce their speed so that the pipe is not jarred when table stops. No iron rings or pallets are required. By making pipe bell down, the bell-end is made as dense as the cylinder of the pipe. By placing bell ring in table, instead of operating it by hand the output is increased, the quality of the pipe at the bell is perfect and labor is reduced.

Construction of Machine

A side elevation of the machine, mixer, conveyor and so on, is shown in Fig. 1. This is a double unit, making two pipe of the same size or different sizes at the same time. The machine erected is shown in Fig. 2 from a photograph.

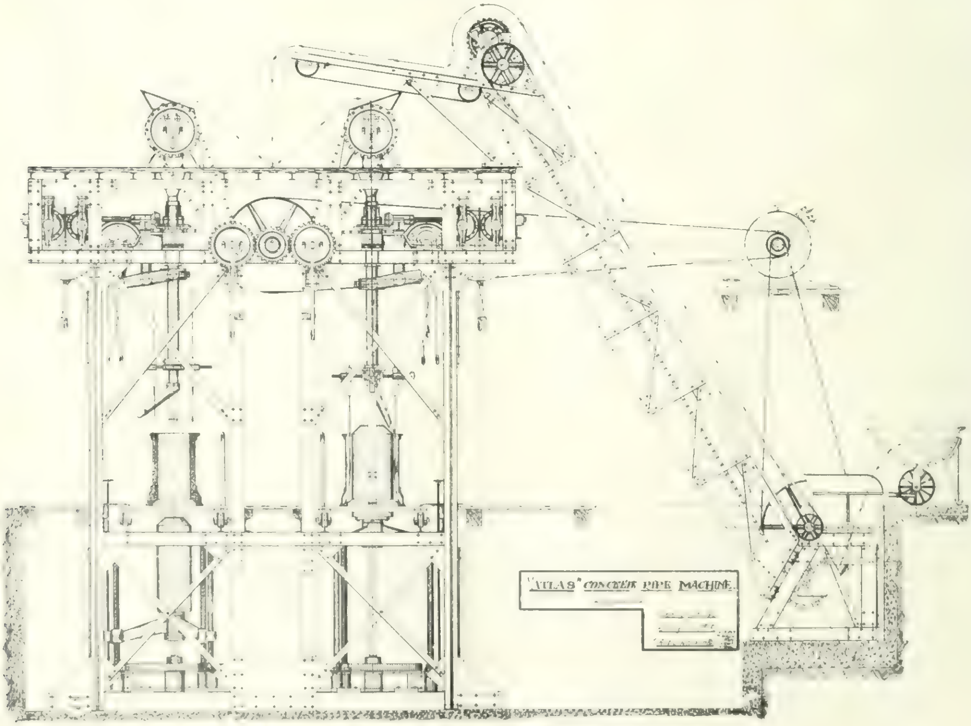


Fig. 1—Side Elevation of Double Unit Concrete Pipe Machine

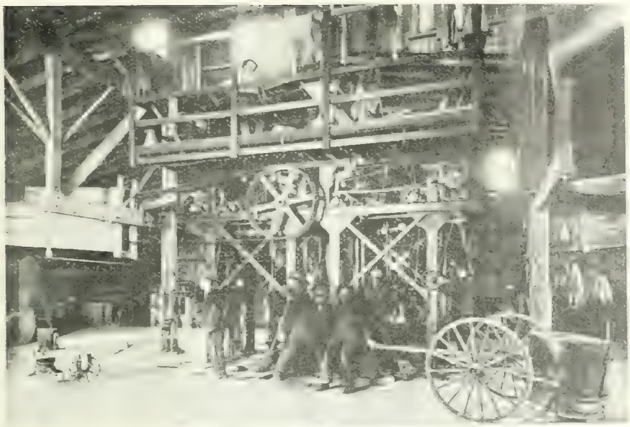


Fig. 2—Atlas Machine as Erected

The frame is composed of structural steel channels and angles, rigidly braced by gusset plates and riveted together by compressed air. The frame is in two sections, both identically the same but so arranged that when placed end to end, they may be bolted together to form one solid double frame. The machinery itself is secured to the frame by machine bolts, driven through reamed holes, thereby allowing no lateral motion. All parts of the machine are made extra heavy with extra long bearings of high grade babbitt. The shafts are all turned and are of the best steel and all parts are made to a press fit and are also keyed. All gears are machine cut and of steel, except some of the largest, which are machine-cut of cast iron. Clutches used are of steel with long bearings for the moving parts and brass bushed. Where-ever a collar is used, the set screw is displaced by a steel pin through the collar and shaft and riveted at either end. Some sprocket chain is used but in order to have no trouble from this source, an auto-truck chain of the Whitney type is used and run on steel sprockets. The frictions are of bronze and carry cold rolled steel tampers, to which are riveted steel blades, to which the feet are attached. These blades are used to allow the feet to spring out from the bell ring and tamp the bell of the pipe. These blades are made by the Simonds Saw Co., and are of the very best grade of saw steel. The cores are made of a composition of very hard gray iron, turned and polished. The jackets are made of the best gray iron, machined inside at top and bottom, with a steel plate center rolled to the proper diameter and riveted to the top and bottom castings. They are reinforced along the joint with angles, and are held together by means of an eccentric clamp of special design which may be applied and removed instantly. The carts which are used for carrying the jackets have wood wheels, steel axle, angle frame and pipe handle. They are very simple and durable. A cart is shown in the right foreground, Fig. 2. The mixer is of the pug-mill type, but has a paddle or blade of a shape peculiar to the needs of the machine. The conveyors are of the belt and bucket type. The feed hoppers are small type pug-mills. The paddles carry the material to one end where a star-shaped steel casting, called a digger, having six spokes, loosens the material and kicks it through the opening into the funnel of the feed pipe. The feed hoppers have thick cast iron heads with steel shell and are bolted together. The tables are heavy cast iron, machined on the face and have roller bearing wheels which run upon a V-shaped track. They are moved backward and forward by means of a worm and gear mounted below to which is attached a crank pin connected to a vertical bar, pivoted at its lower end. By the turning of this worm gear half its circumference, the vertical bar is moved backwards and forwards and each motion moves the table to the extremity of its travel one way or the other. The worm and gear are heavy gray iron castings. An automatic and dirt-proof oiling device is employed by which a constant supply is conveyed through tubes, displacing entirely the open oil or grease cup.

Operation of Machine

By means of a lever convenient to the hand of the operator, the clutch upon the eccentric shaft is engaged, thereby causing the tube situated above the mold to reciprocate or assume an up-and-down motion or stroke. At the same time the friction lever, being in its outward position, places the friction wheels against the disc and the tube is caused to revolve around the wall of the pipe. With the aid of a lever, the clutch mounted upon the feed hopper is engaged, thereby causing it to deliver the mixed concrete into the funnel, passing through the tube and spout at the lower end, into the mold. This feed tube revolves with the tampers but does not assume the up and down motion of the tampers. The spout at the lower end of the tube revolves with the tube thereby delivering into the jacket a steady stream of concrete. Upon this material the tampers strike with heavy, rapid blows so that the entire space betwen the core and the jacket is covered by the four tampers as they travel around the forming pipe—two being close to the core and two next to the jacket.

After an accurately measured batch of sand, gravel and cement has been placed in the mixer and the required amount of water added, the mass is thoroughly mixed in a specially designed open top paddle mixer. With the aid of a lever the entire charge is dropped into the boot of the conveyor from which it is delivered to a platform on the top of the machine. In order to secure perfect regulation of the feed, the material is shoveled from this platform into the feed hoppers.

The beveled bell ring causes the flexible steel tampers to slide off and deliver their blows into the deepest part of the bell, which, with additional moisture and more powerful tamping, is made extremely dense. This tamping process goes on until the pipe is completed and produces a uniform density, beginning with the bell and extending to the spigot end of the pipe. As the material is rammed into the mold, the tampers are forced upward through their frictions until they have reached the top, when the pipe is completed; then the surplus material is struck off and the spigot end of the pipe troweled smoothly.

The core comes up from beneath the table, revolving as it rises. When in position the feed is started and the core continues to revolve during the formation of the pipe. The revolving core trowels the interior surface of the pipe so perfectly that the fine particles of sand and cement are brought to the interior face of the pipe, thereby forming an impermeable surface. This troweling continues until the top has been reached, or as much longer as may be required. The unlimited revolving of the core gives the interior of the pipe a uniform troweling throughout. When the spigot end of the pipe is finished, the revolving core is lowered, by a downward pressure of the foot upon the lever provided for that purpose, and automatically stops below the table.

By means of another foot lever, the tables may be shifted, carrying the finished pipe out from under the machine and placing an empty jacket in position to receive the core. At this point the rotating of the core is reversed and by the pressure of the foot upon the lever, the core is brought up through the table into position in the empty mold, automatically stopping at the top, whereupon the tampers are dropped by releasing the frictions and the operation resumed for the manufacture of another pipe.

When the table shifts, the newly made pipe is in position to be picked up on the forks of a cart, which enables the jacket containing the green pipe to turn bell up on its lugs without the slightest disturbance occurring in the mass of the pipe. The cart then conveys the pipe to the steam curing room where it is set on the floor spigot-end down and the jacket removed. No rings or pallets are necessary to support the pipe as its density holds it in perfect rigidity. A metal band preserves the perfect shape of the bell during the removal of the jacket. This band is allowed to remain on for a short time until the pipe is sufficiently set for its removal.

Capacity

The manufacturers guarantee a capacity for each single unit machine operated by men of average skill and ability, as follows:

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]			
[illegible]		[illegible]			
[illegible]		650'	[illegible]		
[illegible]		[illegible]			
[illegible]		[illegible]		[illegible]	
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]			
24 in.	"	350'	"	"	"
[illegible]	[illegible]	[illegible]		[illegible]	

The 4-in. and the 6-in. pipe are in 24-in. lengths and the larger sizes in 30-in. lengths. Any two of these quantities are guaranteed with a double [illegible]

Tests

Tests made of Atlas pipe, by the Kansas City Testing Laboratory, are summarized as follows: 15-in. internal diameter pipes, 24-in. long with 2-in. bell giving total length of 26 inches, 1½" thick, 28 days and made of Iola cement 1 part and Kaw River sand 3 parts, showed an average crushing strength of 2,913⅓ lbs., or 1,748⅓ lbs. per lin. ft. The strength required by city specifications is 1,300 lbs. per lin. ft.

Hydrostatic tests were made as follows:

	Pipe No. 1	Pipe No. [illegible]
[illegible]	[illegible]"	[illegible]"
[illegible]	[illegible]	[illegible]
[illegible]		
[illegible]	[illegible]	[illegible]
[illegible]		

RESULTS

	Pipe No. 1 (12-in.)	Pipe No. [illegible] (8-in.)
[illegible]	[illegible]	[illegible]

20 pounds pressure, percolation—None—None (pressure held [illegible]
30 pounds pressure, percolation—None—None (pressure held [illegible]
40 pounds pressure, percolation—None—None (pressure held [illegible]
60 pounds pressure, percolation—None [illegible]
75 pounds pressure, percolation—Fractured

Required by City Specifications: No percolation up to 10 lbs. per sq. in. pressure—and no fracture up to 33 lbs. pressure per sq. in.—internal pressure.

Drop weight tests were as follows:

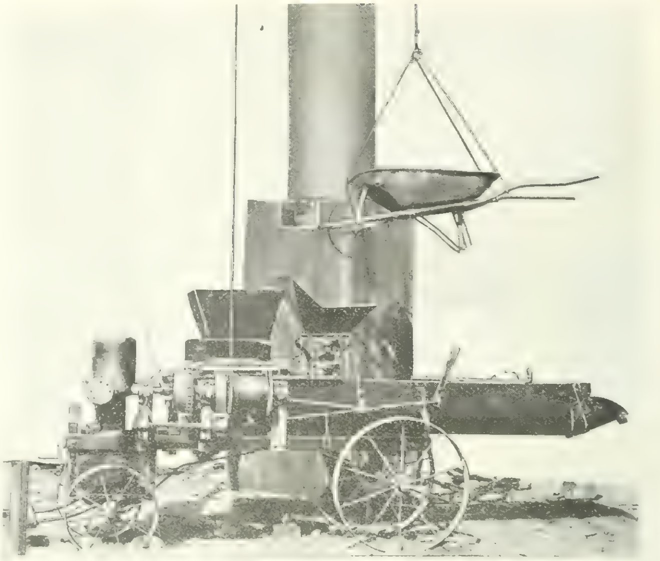
Pipe, supported on a dry sand bed 2" deep, shall withstand without cracking the impact from two blows of a cast-iron ball weighing 10 lbs., falling 18". (City Specification for Concrete Sewer Pipe.)

Pipes Tested:	No. 1	No. 2
Diameter internally	18"	12"
[illegible]	[illegible]	[illegible]
Mixture	1 cement: 2½ sand	

[illegible]

	Pipe No. 1 (18")	Pipe No. 2 (12")
[illegible]	[illegible]	[illegible]
[illegible]		
18 inches, 2 blows....	No effect	No effect
10 pound weight dropped		
24 inches, 2 blows....	No effect	No effect
10 pound weight dropped		
36 inches, 2 blows....	No effect	Broke
10 pound weight dropped		
48 inches, 1 blow.....	Broke	

Required by City Specifications: Shall withstand cracking from two blows from 10-lb. ball from impact dropping height of 18".



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Hoisting Equipment on Mixers

In order to meet the added demands of the different contractors the Hall-Holmes Mfg. Co., Jackson, Mich., has recently added to its "Baby Grand" mixer a single drum hoist. This was done in order to give the silo or chimney stack builder efficient equipment for his work.

The hoist is direct connected to the frame of the mixer and is strong and rigid. Power is derived from the main counter-shaft of the machine by means of a sprocket and steel pintle chain. The hoist is so attached to the mixer that it can be run while the machine is in operation or while the mixing and feeding arrangements proper are standing still. This enables the contractor to use his hoist either in connection with or independent of the mixer. The hoist is equipped with a drum of sufficient size to carry at least 200' of ⅜-in. wire cable. This drum is also operated by friction clutch and brake-band so that the hoist can be started and stopped by means of the friction clutch without any sudden jar to the machine. The hoist can be thrown out at any point and the friction applied so that the load can be stopped and held at any point desired. This enables the silo contractor to draw up a wheelbarrow full of concrete, hold it at any desired point and dump it. The wheelbarrow will then return to the ground by force of gravity as soon as the friction is released.

The hoist will elevate at the rate of 100 ft. per min. about 400 lbs. or an ordinary wheelbarrow full of concrete. The larger machines also are equipped with this hoist as well as the mortar mixer. Many contractors desire this arrangement in connection with mortar mixers for elevating mortar and brick. In equipping the concrete and mortar mixers with this hoist the contractor is given two complete equipments in one at a very small additional cost, in fact, for less than they could purchase even a hand hoist for this work.

* * *

The Laclede Steel Co., St. Louis, manufacturer of rail carbon steel bars for reinforcing work, angles and agricultural shapes, announces the appointment of Theodore Geissmann & Co., Inc., 72 W. Adams St., Chicago, as authorized District Sales Agent in the Central West.

* * *

Wilbur J. Watson and Co., cons. engrs., Cleveland, have moved from 1328 Citizens Bldg. to 1150 Leader Bldg., Superior Ave. and E. 6th St., Cleveland. The new quarters afford larger space and a better arrangement.

* * *

The Canadian agency for the Orenstein-Arthur Koppel Co., Koppel, Pa., has been given to the Canadian Fairbanks-Morse Co., having offices in Montreal, St. John, Toronto, Winnipeg, Saskatoon, Calgary, Ottawa, Vancouver and Victoria.

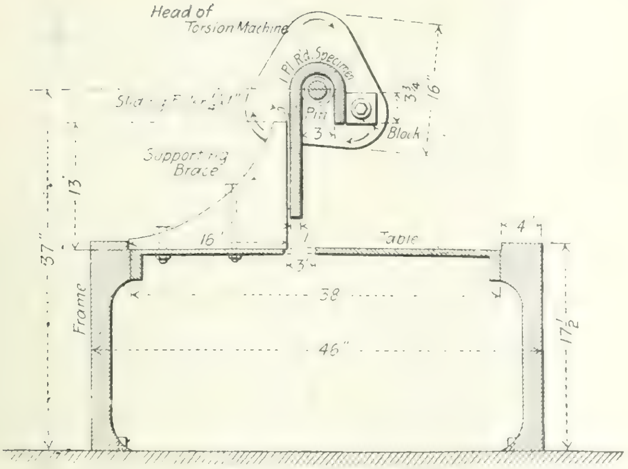

Fig. 1—Sectional Sketch Showing the Head of a Torsion Machine Arranged for Bending Tests

Re-Rolled Steel Rail Reinforcing

(Continued from page [illegible])

the successive passes through the rolls For this purpose new Bessemer rails of 60-lb. and 75-lb. section were secured, and samples taken at the various passes, including the finished bar. Samples were also cut from the original rails.

Method of Testing

All bars were tested in the manufactured form without surfacing.

Tension Tests.—The tension test was made under the usual conditions, with observations of the yield point (by the drop of beam), ultimate strength, elongation and reduction. The bars were inspected before test for surface defects, evidence of over-heating, etc. The speed of test was ¾" per min. on the 300,000-lb. machine and 1/3" per min. on the 30,000-lb. machine.

The usual difficulty was found in producing fracture in the gauge length in the case of twisted bars. The influences operating in this case were the crushing of the edges of the twisted bar by the grips and the possible torsion and bending due to eccentric gripping. This influence operated more to prejudice tests of large twisted bars than small twisted bars, and the breaks outside the grips were more frequent in the case of bars of high strength.

Since a break outside of the gauge length is a matter pertaining to the technique of testing rather than to the quality of the manufactured article, the ordinary procedure was adopted only those bars which broke inside the gauge length were used to furnish data for this report.

It would have been possible to model grips to fit the twisted bars if only one or two sizes of twisted bars had been collected. With the variety of sizes and variation of pitch represented in the samples, however, it was considered impracticable to supply such a collection of grips.

Bend Tests.—After one end of the 3-ft. bar had been pulled, the other end, which was unaffected by the tension test, was bent cold; that is, at the temperature of the laboratory (70° F.) The machine used was the twisting head of a Riehle 200,000-in.-lb. torsion machine which supplied a steady twisting moment The diameter of pin used was that specified in the proposed Standard Specifications for Rail-Steel Concrete Reinforcement Bars presented for adoption at this annual meeting of the Society, as follows: For high-grade plain bars, 3 times the thickness; for deformed bars, 4 times the thickness.

For the purpose of this investigation twisted bars were tested as manufactured.

The method of making the bend test is illustrated in Fig. 1. Provision was made for the creeping of the end of the bar. The final bend procured was the full angle recorded. It was, of course, necessary to bend the bar to a somewhat greater angle, so that the recorded angle would be the net angle after the spring had disappeared from the bar

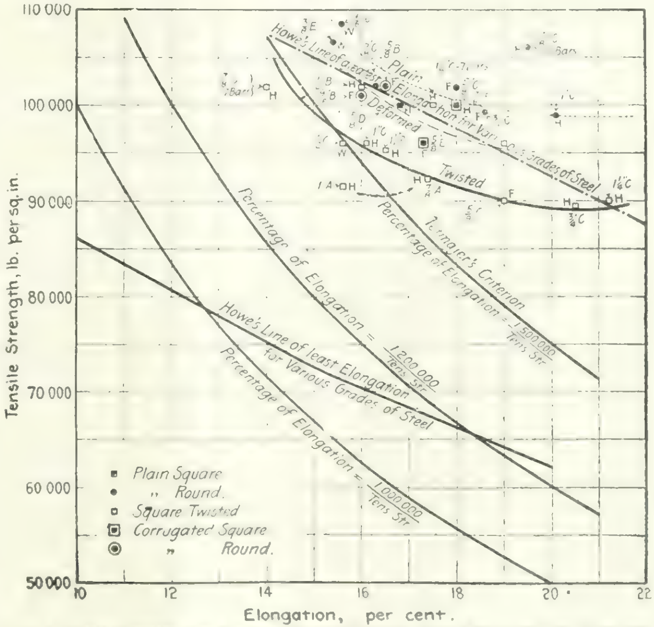

Fig. 2—Chart Showing [illegible] Between Tensile Strength and Elongation

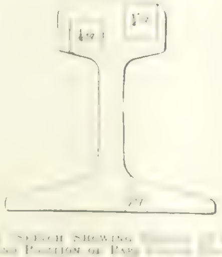

Fig. 3—Sketch Showing [illegible] and Position of [illegible] Head and Flange

Mechanical Nature of Material

The results of tests are shown in the complete report in detailed diagrams, general diagrams and tables.

Tension Tests.—A comparison of this re-rolled rail steel of various design with other grades of steel is most readily made by plotting a curve of elongation against strength in the manner used by Tetmajer. This has been done

Table III—[illegible] Re-Rolled From 55 lb. and 80 lb. Rails

Size and Weight of Rail.	Size and Kind of Bar.	Location in Rail.	Mill.	Tensile Strength, lb. per sq. in.	Elongation, per cent.
5-in.-80 lb. . .	$\frac{1}{2}$-in. Sq. Tw.	Web	C	97 700	15.2
" "	$\frac{5}{8}$ " "	Flange	"	91 100	19.4
" "	$\frac{7}{8}$ " "	Head	"	101 400	14.0
" "	1 " "	"	"	95 900	16.0
" "	$1\frac{1}{8}$ " "	"	"	100 200	14.1
Average				97 300	15.9
4-in.-55 lb.	$\frac{1}{2}$-in. Sq. Tw.	Web	C	86 700	18.6
" "	$\frac{5}{8}$ " "	Flange	"	85 300	19.4
" "	$\frac{7}{8}$ " "	Head	A	92 100	17.3
" "	1 " "	"	"	91 200	15.8
" "	$1\frac{1}{8}$ " "	"	B	95 100	16.4
Average				90 100	17.5

in Fig. 2 and on this have also been drawn:

1. Howe's lines of common greatest and least elongation for various grades of steel[1]

2. Tetmajer's curve of good quality of steel, that is:

Elongation=1,500,000÷tensile strength.

It will be seen from these (1) that the re-rolled steel has an excess ductility for its strength above usual grades of steel; and (2) that the twisted bars yield, as a rule, a smaller product of strength and elongation than the plain or deformed.

Bend Tests.—An estimate of the degree of bending to which these bars will submit may be obtained from Table I, which is abstracted as follows:

PLAIN AND DEFORMED BARS.

Under ¾"—97.0% of the bars bent to 180°; minimum single bend was 55°.

¾" and over.—97.6% of the bars bent to 90°; minimum single bend was 40°.

TWISTED BARS.

Under ¾"—96.5% of the bars bent to 180°; minimum single bend was 75°.

¾" and over.—93.2% of the bars bent to 180°; minimum single bend was 20°.

The writer believes that the diameter of pin specified for the larger bars is not in correct relation to that specified for the smaller bars. If a bar less than ¾" calls for a pin of diameter three times the thickness of the test bar, with a bend of 180°, then the larger bars should bend 90° around a pin of diameter six times the thickness of the test bar. The present specifications provide a pin of diameter four times the thickness of the bar.

Effect of Various Factors Upon the Results

The samples were collected to represent the output under commercial mill conditions, so that there was no attempt, except in the series of new rails, to impose artificial conditions necessary to determine the effect due to the continued variation of each of the several factors, namely: design of bar, size of bar, original position in rail, kind of rail, mill practice, rolling temperature, rate of cooling, and size of rail. However, a wide range of kind and size of bar was secured, and the samples permit a comparison of these variable factors. The comparisons are shown in diagrammatic form.

The qualities of the various sizes of bars are of course affected by the amount of reduction, the rolling temperature and rate of cooling, and also by the fact that the larger bars come usually from the head of the rail; so that, as a matter of fact, the size and position in the rail are interdependent.

The origin of the material is, however, the most persistent factor, as is shown in Table II, so that in determining effects of size and design we shall separate first as to origin.

1. *Comparison of Material from Head, Web and Flange.*—Table II shows

Table IV—Summary Showing Effect of Re-Rolling
75 lb. Rail

Position in Rail.	Properties Considered.	Original Rail.	Rerolled Rail
Head. . .	Tensile Strength, lb. per sq. in.	97 150	93 480
	Elongation, per cent.	14.80	20.16
	Product.	1 370 000	1 890 000
Flange.	Tensile Strength, lb. per sq. in.	99 000	96 580
	Elongation, per cent.	16.70	19.20
	Product.	1 650 000	1 850 000
	60-lb. Rail.		
Head.	Tensile Strength, lb. per sq. in.	94 130	94 940
	Elongation, per cent.	17.2	20.6
	Product.	1 619 000	1 955 760

Table V—Relation Between Strength and Elongation

Kind of Bars.	Percentage of Elongation times Tensile Strength.	Percentage of Elongation times Yield Point.
Plain.	1·650 000 – 2 000 000	900 000 – 1 380 000
Deformed.	1 700 000	1 050 000 – 1 137 000
Twisted.	1 400 000 – 1 900 000	750 000 – 1 220 000

Table VI—Average Mechanical Properties of Re-Rolled Rail Bars

Properties Considered	Range of Average Properties	
	Deformed and Plain Bars.	Hot-twisted Bars.
Tensile strength, lb. per sq. in.	98 600 – 108 500	90 000 – 102 000
Yield point, lb. per sq. in.	60 000 – 75 000	55 000 – 65 000
Elongation in 8 in., per cent.	15.2 – 20.1	14.0 – 21.1

Table VII—Table Showing Acceptances Under Present Specifications

Kind.	Size of Bars	Percentage of Number of Bars passing				
		Bend.	Tensile Strength	Yield Point	Elongation	All Tests.
Twisted Bars.	All	92.1	94.1	95.9	95.0	83.4
	1 in. and below	92.0	94.6	96.4	95.0	84.0
	$\frac{3}{4}$ in. and below	97.0	96.0	98.7	99.3	92.0
Other Bars	All	97.2	99.0	. . . . .	98.2	95.1
	1 in. and below	98.0	99.0	98.2	98.3	95.7
	$\frac{3}{4}$ in. and below . .	99.0	99.2	100.0	99.0	97.0

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[1] [illegible]

a distinct classification of material upon the basis of its origin. The web bars are harder than those from the head, and the flange bars softer than the head bars. Thus with the head as 100%:

Position in Rail	Percentage Variation in Tensile Strength	Percentage Variation in Elongation
Web	103.7	86.0
Head	100.0	100.0
Flange	95.0	98.0

2. *Comparison of Size of Bar.*—The groups of like origin and mill manufacture are connected and the general tendency of each group is toward decrease of strength and increase of elongation as the size of bars increases. However, part of this general tendency for all the groups considered together is owing to the larger sizes of bars being twisted bars.

3. *Comparison of Design of Bar.*—The plain round bars are the strongest and the twisted bars the weakest. Thus, for material from the flange:

Design of Bars	Tensile Strength lbs. per sq. in.	Elongation %
Plain Round	99 800	18.2
Deformed Round	101 400	16.3
Deformed Square	95 600	17.3
Square Twisted	90 000	18.8

In the case of material from the head of the rail, the indications are not so clear. The various designs of smaller bars are of practically the same quality, but the twisted bars of large size are of less strength than the other designs. This is partly accounted for by the fact that the harder twisted bars of large size have been automatically weeded out from the averages because they broke mainly outside the gauge length.

4. *Size of Rail.*—The results of the tests from rails of varying sections are given in Table III.

5. *Relation between Re-rolled Bars and Original Rail.*—A special series of tests was made to determine:

(*a*) Relation between the re-rolled bar and the original rail;

(*b*) Changes in mechanical properties at successive passes.

For this purpose new rails were used because it was thus possible to secure several rails of known and uniform composition. In this way the one changing condition could be isolated and the effect determined with fewest tests and least labor, and least interference with the business of the mill.

P. E. Carhart, of the Illinois Steel Co., was kind enough to supply five Bessemer seconds of following composition:

Rail No.	Weight per Yard lb.	Blow No.	Chemical Composition, %		
			Carbon	Manganese	[illegible]
1	75	41913-C	0.42		
2	75	[illegible]	0.40		
3	75	[illegible]	0.41		
4	75	41911-C	0.43		
5	75	[illegible]	0.41		
6	60	43418-B	0.41		0.034
7	60	43418-B	0.41	0.90	0.034
8	60	43418-C	0.41		0.034
9	60	43409-C	0.38	0.88	0.038
10	60	43401-C	0.38	0.87	0.026

These rails were seconds, physically; each was cut into three lengths, and a short piece 1′ 6″ long. Thus each rail is represented by three pieces, 1*A*, 1*B*, 1*C*, about 10 ft. long, and a short piece which was used to furnish tension tests. Of the latter there are three, two from the head, and one from the flange, as shown in Fig. 3.

The head and web of the 10-ft. lengths were rolled into plain reinforcing bars at the Chicago Heights Mill of the Calumet Steel Co., and samples were cut from the bars at successive passes through the rolls. The head was reduced about six times in a cross-section and the web about 11 times. The changes between the original rail and the re-rolled bar for both the 60-lb. and 75-lb. rails are summarized in Table IV.

It is apparent that the process of re-rolling has raised the mechanical quality of this material, and has brought nearer together the divergent material from the head and the flange.

Variability of Product

While the average material is sufficiently high in quality, it is still necessary to determine whether or not the material is uniform. For this purpose the variability of the tests must be determined. This is shown by several tables and diagrams and it can be stated in general that 90% of the tests lie within a variation of 15% (plus to minus) of the average and the remaining 10% exhibit an increasing variability up to 30%.

This variability is based upon a sufficient number of tests, and it may be assumed that the maximum and minimum values have been determined. To judge of the significance of the variability, this range should be compared with the range of other classes of steel with which we have had experience, and for which rules are fixed.

Discussion of Variability.—The writer has not had access to any series of tests comparable to these, from which he might derive similar data of variability. A range of individual bars from +12% to −12% of the average corresponds to the specification limits of from 55,000 lbs. to 70,000 lbs. per sq. in. set for the tensile strength of structural steel reinforcing bars. It will be seen that, on the average, 80% of the re-rolled bars lie within this range. The variability of the yield point is nearly of the same degree as that of the tensile strength.

The variability of high-carbon billet steel used for reinforcing bars should be known for comparison with the writer's tests, but no data are available to the writer.

One important application of the variability data is in fixing a lot test, that is, the number of tons represented by a sample bar. The present specifications for high-carbon billet reinforcing bars fix one test per 10-ton lot. In the case of re-rolled rail steel, the variation in the carbon content of rails of varying section should be recognized. Inasmuch as the re-rolling mills must fix their rolls for a rail of given width of base, any run of the mill must include rails of nearly the same section; so that, in fixing a lot for testing, the variation in the quality of steel from rails of varying size will be met by specifying that the lot to be sampled shall be rolled from rails differing not more than 10 lbs. in nominal weight of section. On this basis a lot of the size equal to that specified for high-carbon billet steel may be used.

Reinforcing Steel in Building Construction

Some facts of reinforced concrete building construction will be useful in judging of the variability to be allowed in reinforcing steel. A reinforced concrete unit, such as a beam, slab or column, employs a number of bars. Thus, in a band of bars in a flat slab there may be as many as 20 bars, of small size, below ¾″; in an ordinary one-way slab, as many as 12 bars in a width that acts integrally; in a column, 4 bars to 20 bars; in a beam, 5 bars to 12 bars; in a footing, more than 25 bars. It should be recognized that the tendency in reinforced concrete building construction is toward flat slabs, and spiral columns, all of which use small rods. The nature of concrete is to spread loads, and average up physical conditions. It would appear that a greater variability of product is therefore admissible than in other steel structures, where a structural unit comprehends a few bars.

Bars in concrete are protected from sharp impacts and sudden loads, and do not need the same toughness as in other structures. Nor are they subjected to the shop processes that demand a tough material. Large concrete bars are, however, usually bent with a maximum bend of 45°, small bars to 90° and at times to 180°. Here a certain toughness is required, and the bars receive effective field test when they are bent. In Europe it is common to give short bends for anchorage, and in this country for stirrups. Difficult bends on large bars should not be made cold.

Application of Present Specification to Results of Tests

In order intelligently to prepare a specification, the results of its application to the product should be determined. The specification should fairly well represent the product and the inspector should not have to reject an undue proportion of the product; nor should the requirements of the specification be fixed so low that all of the product would be accepted under them.

The present specifications of the Am. Soc. for Testing Materials for reinforcing bars of hard grade have been applied to these tests. The hot-twisted bars were classed as deformed bars.

The results of the present application will be more severe than in practice because, first, some bars were tested that would be rejected on inspection; and second, none of the deformed bars was planed to uniform section.

Not enough samples were collected of material beyond 1 in. in diameter, and moreover the 1¼-in. and 1⅛-in. bars from Mill C represent material that would have been rejected upon surface inspection, so that the results of bars 1" and below would be more significant of the facts than the entire series of tests.

In drawing general conclusions it is necessary to separate those bars above 1 in. in diameter. Whether or not plain bars of this size would be any better is not known, because none was collected. However, the indications are that the twisted bars are inferior to the others. It should be stated, however, that the difficulty of re-rolling good material will increase with the size of bar for the reason that there will not be enough reduction from the head of the rail to the finished bar, and any flaw or segregations in the head of the original rail are not so likely to be effaced in the rolls.

It is difficult to find rails of sufficiently large head to roll such large bars as 1⅛" and 1¼". The proportion of the product rolled in these sizes is small.

It will be noticed that the twisted bars fail more often under the bend test than under the other forms of test. This is probably due partly to the fact that those tension bars which broke outside the gauge length are not included in the tension test averages.

An Appreciation of the Monolithic Concrete Silo

No single farm innovation of recent years has offered to the American farmer such a paying investment as the silo offers. This invaluable food storehouse represents such a saving that some of our western states are considering the appropriation of money to be loaned to farmers for silo building, and bankers have agreed to lower their rates on money loaned for the same purpose. Yet the silo is comparatively new. It has, within a few years only, passed out of the experimental stage. All shapes, sizes, and materials for silos have been tried, but the circular monolithic concrete type, despite a somewhat higher initial cost, has proved itself most efficient and cheaper in the long run. In fact, so peculiarly and completely does this type meet the requirements of the perfect silo, that concrete seems almost to have been created for the purpose. A consideration of these peculiar requirements will enable us to see how true this is.

Theory of Silage

Any housewife knows that canned fruit will not keep unless the cans are air-tight. Germs of fermentation get very busy if oxygen is freely admitted and if too much air gets in, the fruit has to be thrown out. Silage works on the same principle. If the excess of oxygen can be kept from the green chopped corn and cornstalk, the silage can be preserved for an indefinite period. As soon as a silo is filled fermentation is set up and continues as long as there is oxygen supplied to keep the process going. The problem in the silo is to have the corn neither too green nor too ripe, and to pack it so that the fermentation will be uniform and will continue a short time only. (This, of course, excepts the necessarily exposed layer on top). Too long fermentation means sour silage, and sour silage is neither so inviting nor so nutritious to cattle as sweet silage. The silo must be practically air-tight and the walls must be smooth and free from sharp angles, so that every possible chance for imperfect settling may be eliminated.

The Qualifications of the Perfect Silo

With this understanding of silage, the principal requirements for the silo are readily appreciated. Some of the following demands proceed from nothing more or less than common good judgment, but most of them depend directly on the fact that only a limited amount of air must be admitted—simply enough to start the fermentation.

The Efficient Silo—

1. Must be air-tight and water-tight. If air can pass in or water pass out, the silo is a destroyer instead of a preserver. Too much air means sour silage and too little water means dry silage and both sour silage and dry silage mean heavy loss. Therefore, any silo whose material expands or shrinks with heat or cold, wet or dry weather, *can not* keep from developing air gaps and leaks and is consequently dangerous.

2. Must be smooth on the inside. This matter is merely corollary to the demand that the silo be air-tight. A rough inside wall or any sharp angle is liable to retard or interfere with the settling of silage and thus create air gaps or pockets. This is the reason that the round silo has triumphed over all others.

3. Must be vermin proof. This is another corollary to the first requirement. If rats and mice can gnaw through, air and water will follow their path. If the whole efficiency of a silo is in jeopardy from the tooth of one small mouse, the silo is a risky investment and a foolish attempt at economy.

4. Must be fireproof. Rates for farm fire insurance are extra high. When fire breaks out on the farm the only thing that usually stops it is the lack of something to burn. The insurance companies, in order to insure themselves, have to run the rates up and of course the farmer pays the bill. A silo that contains food supply for half a year or more should be made absolutely secure against the fire demon.

5. Must be free from the need of repairs. This sounds considerably like a dream. In modern days of the high cost of up-keep we have come to regard initial cost as a small matter—we instinctively figure on breaks and various other accidents. If one silo can be made that is absolutely free from upkeep and repair, all other silos are inefficient and truly high priced.

6. Must be durable and permanent. Durability is the backbone of economy. How long will it last and how much will it cost per day during its life are the pertinent questions. To be efficient a silo must render long service, it must not be at the mercy of fire, lightning, windstorms and earthquakes. Durability is the cheapest thing on earth—no matter how much it costs. If an everlasting, repair-proof silo is possible, all others are impossible.

The Monolithic Concrete Silo

Recall the foregoing requirements—get them well in mind. Then consider the following proved claims for the concrete silo. The *monolithic concrete silo* is the acme of durability, never needs repair, is absolutely fireproof, is air-tight and water-tight, is smooth on the inside, and defies the ravages of all vermin. When properly constructed (and proper construction is now a simple matter) it *can not* warp, rot, crack, burn, leak, blow over, or waste away. There is not much left for one to ask for. There is not a single requirement that the monolithic concrete silo does not answer instantly. No objection against it has ever been sustained. Only two objections need even to be answered.

The notion that silo juices and acids eat into concrete and disintegrate it is an idle alarm, dreamed by the man who wants to sell some other kind, and is disproved by thousands of successful and happy users of the concrete type. "Ask the man who owns one." The other objection, that the cost is too high, is also false and superficial. Anything costs as much as you pay for it, plus the repair bills, plus 100% when you have to replace it. The monolithic concrete silo *never* needs repair and *never* has to be replaced. First cost is total cost. The way to decrease cost is to eliminate upkeep and repair—figure on service for 10, 20, 50 or 100 years. The strength of concrete is cumulative, ever increasing, and the silo built of it is truly cheap and not cheaply cheap.

These are the reasons that the demand for the concrete silo is so great and the field of work so broad.

Artcrete. Hall Concrete Products Co., Inc., Philadelphia, 12" x 9" size, 50 pp., illust., paper. This is an elaborate catalog of the ornamental concrete products of the Hall company, including garden furniture of practically every nature.

Concrete-Cement Age

Vol. III AUGUST, 1913 No. 2

Editorials

LE CIMENT ARME in a recent number thinks that the last straw of the attack upon concrete construction is the allegation on the part of its adversaries that the material has too much resistance and that the demolition of concrete construction costs too much money. In a very funny way the writer replies to the allegation by showing that in previous days the lack of permanence was the ground upon which the use of concrete was criticised. Adversaries of concrete have now changed their point of view and as a natural result they find themselves in a position of advocating temporary construction with very little lasting power or the construction of demountable parts which could be used again for other work. Even this last charge might be met, our French contemporary says, by following our American practice of making unit construction, or concrete lumber, so that the building could be taken apart and its members used again for other work.

* * *

IN THIS issue is described a system of wall construction which uses a small light pre-cast concrete unit. In many ways this system seems to open up an entirely new field in concrete construction, or at least opens up an old field in a new way. Our heavy concrete construction has been scientifically developed to a high degree of efficiency so that unit costs on concrete work are very low. The big problem has been, however, to get to the small isolated work, such as the average small house, some relative proportion of this economy. The inventors of the system described in the following pages make the claim that with the plural mold system of casting, what practically amounts to concrete lumber can be manufactured at about half the cost of wood siding at present retail prices. If this is possible and if a system of erection with such "lumber" can be perfected, a great field should be opened up.

* * *

WHEN THE fireproof qualities of concrete construction are considered, it seems almost criminal, in the face of figures recently published by *Safety Engineering,* to build any institutional buildings for the care of public charges or for charitable purposes except of fireproof construction. According to a compilation of statistics of fires since January 1st, 1908, of buildings of an institutional character, it appears that the number of fires were 326, the amount of losses $6,500,000, the average loss per fire $20,000 and that over 43 lives were lost, to say nothing of numerous people injured in the various conflagrations.

It would seem that by a glance through the list of the various kinds of institutions destroyed that a building of this character burns wholly or in part every five and one-half days. While these figures apply to typical institution building fires in edifices such as almshouses, memorial halls, hospitals, lunatic asylums and other similar edifices, sight must not be lost of the destruction of life and damage to property by fire taking place in school buildings, theaters, hospitals, public halls and other buildings devoted to public uses. The time is not far distant when public sentiment will compel fireproof construction in every case of this kind, and laws will be made to enforce responsibility for failure properly to protect life and property by means of proper building construction.

* * *

Accelerated Tests for Cement

In the July, 1913, issue, CONCRETE-CEMENT AGE published the paper by Henry J. Force read at the recent meeting of the Am. Soc. for Test Mat. "The object of the paper," as stated by the writer, is "to give the results of tests on various brands of cement, some of which failed and others of which passed the autoclave test." In considering a paper referring to results stated to have been obtained with a "test" not known to any of the standard specifications and a "test," the definite requirements of which the writer's paper does not state, it is necessary to deal with the matter in a broad way with reference to the existing state of specifications in the cement industry and with due regard to the rights of both consumers and producers. It is also necessary to deal with the history of accelerated tests in Europe and in this country and with the history relating to the making of specifications.

Early Tests for Constancy of Volume

As far back as 1889, when the fabrication of Portland cement was in its infancy in this country and beginning to obtain a wider market in Europe, numerous suggestions were made by Tetmajer, Maclay and others for new methods of testing the well-known article, Portland cement. The discussion of these accelerated tests led to the presentation of numerous papers by Faija, Maclay, Lewis and Blair and to full descriptions of other proposed tests by Prof. Baker and Prof. Spaulding in their books on hydraulic cements, and to numerous transient articles appearing in the various engineering publications covering a long period of time. The evil that existed in 1896 was that all over the world suggestions were being made as to new methods of testing cements for constancy of volume with an absolute disagreement among all authorities as to the best methods to be used and with absolute indefiniteness on all sides as to the proper procedure. This condition was met by the appointment by the Am. Soc. Civ. Engrs., July 1, 1897, of a committee to report on the proper method and proper manipulation of tests for cement. The committee was organized by the election of Prof. George F. Swain as chairman and Richard L. Humphrey as secretary, the former being succeeded at a later period by George S. Webster, Philadelphia. At the time of the appointment of the committee which dealt with all methods of manipulation of cements, not only with reference to accelerated tests but with the making of test pieces, with the form of briquettes, method of manipulation, etc., etc., the following tests for constancy of volume were under consideration and many of them were in use here and there, according to the whim and fancy of those who desired specifications to suit their own particular point of view. There were the hot water test of Maclay with a temperature of from 195° to 200° F., the boiling test of Tetmajer at 212° F. and there were the kiln tests of Tetmajer at 166° to 248° F., the flame test of Heintzel with the Bunsen burner, the chloride of lime tests of Candlot, the boiling tests of Michaelis at a temperature of 212° F. and over, the compressed cake tests of Pruessing, the high pressure steam tests of Erdmenger and the caliper apparatus test of Baushinger. These, in turn, had their many variations as to form of specimen pats, time after making in which the pats were to stand the tests, time of duration of the accelerated tests, etc., etc.

Work of the Am. Soc. Civ. Engrs.

With these evils of varying requirements before them the committee very properly sent out a communication giving questions for engineers to reply to as to their view of new tests for constancy of volume. According to Vol. 16, proceedings of the Am. Soc. Civ. Engrs., April, 1900, only a small number of answers were received in relation to tests for soundness. "Eleven replies" the committee stated "indicated a preference for the present standards of the Am. Soc. Civ. Engrs." At that time, therefore, the consensus of opinion of the engineering world indicated that the ordinary exposure of pats to cold water and air as prescribed in the old 1885 standards of the Am. Soc. Civ. Engrs. were sufficient safeguards to the engineering public. The committee, however, after thorough investigation and at the end of a period of nearly three years, made its report suggesting the present methods of tests for constancy of volume, namely, that the test pieces should be allowed to remain 24 hrs. in moist air and then exposed for 5 hrs. in any convenient way in an atmosphere of steam above boiling water in a loosely closed vessel.

With that wisdom which marks all the work of the Am. Soc. Civ. Engrs., the committee safeguarded this new test by stating "in the present state of our knowledge, it cannot be said that cement should necessarily be condemned simply for failure to pass the accelerated tests; nor can a cement be considered entirely satisfactory simply because it has passed these tests."

This was the decision at a period when all the varied tests above stated were under discussion and where the high pressure steam test of Erdmenger, which is practically the identical test now recommended by Mr. Force, was well known to consumers, manufacturers and engineers even after it had been discarded in Germany where it originated.

Work of the Am. Soc. for Test. Mat.

June 15, 1902, the Executive committee of the Am. Soc. for Test. Mat. appointed a committee on Standard Specifications for cement of which George F. Swain was made chairman and Richard L. Humphrey secretary. This committee embraced in its membership a number of manufacturers of cement, the entire committee on tests of manipulation of cement of the Am. Soc. Civ. Engrs. and representatives of the Am. Ry. Engrg. and M. of W. Assoc., the president of the Am. Inst. of Architects and a number of representatives of well-known testing laboratories. Feb. 4, 1903, the committee adopted as a basis for its work the report of the Am. Soc. Civ. Engrs. on uniform tests for cement, and subsequently, after elaborate investigation of samples of cement sent to some 30 prominent laboratories for testing in accordance with the methods above referred to, a specification for cement was adopted by the committee and Nov. 14, 1904, it was adopted by letter ballot by the Am. Soc. for Test. Mat. This specification was adopted by the Assn. of Am. Port. Cement Manfrs. June 16, 1904, and by the Am. Ry. Engrg. and M. of W. Assn. March 21, 1905.

In these specifications constancy of volume is dealt with in accordance with the terms of the Am. Soc. Civ. Engrs.' methods of manipulation and again to safeguard the abuse of this test the committee states under their general observations "the failure to meet the requirements of the accelerated tests need not be sufficient cause for rejection. The cement may, however, be held for 28 das. and re-test made at the end of that period, using new sample. Failure to meet the requirements at this time should be considered sufficient cause for rejection." Then followed the excellent opinion quoted above.

Dealing, therefore, with the evil of a multiplicity of tests and a multiplicity of variations in the application of tests, these committees of engineering societies arrived, after six years of work, at the specification which now is in existence and which has been maintained intact for many years.

The U. S. Government Specifications

April 30, 1912, the president of the U. S. approved the work and made public the specifications prepared by the U. S. Govt. Departmental Committee on Specifications for Cement and made binding upon all U. S. officials what he termed the U. S. Govt. Specifications for Portland Cement. This specification, in turn referring to accelerated tests, follows the two already referred to, exposing a pat to steam and atmospheric pressure above boiling water for 5 hrs., as stated in the foregoing specifications.

Internat. Assn. for Test. Mat.

At the Congress of the Internat. Assn. for Test. Mat. held in New York in Sept. 1912, the question of accelerated tests for cement was brought up and after strenuous discussion, in which representatives of practically all nations participated, a resolution was introduced recommending that the task of examining all methods of accelerated tests for the constancy of volume of Portland cement be referred to a committee and "that it should be the consideration of this committee not only to invite experiments by various testing laboratories but also to have some experiments made by some official testing authority in each country concerned."

The Joint Committee

In order to co-relate the work of the three American committees on cement testing to secure what is stated to be "the most important step that has been taken towards the development of uniform methods of tests and standard specifications for cement" by which "a single standard will be adopted for this country" a joint committee consisting of Alfred Noble, George S. Webster and Richard L. Humphrey of the Am. Soc. Civ. Engrs., Arthur P. Davis, Asa E. Philips and Rudolph J. Wig, of the U. S. Govt. Departmental Committee on Specifications for Cement and George F. Swain, Olaf Hoff and Clifford Richardson, of the Am. Soc. for Test. Mat., was appointed and the report of Committee C-1 of the Am. Soc. for Test. Mat. gives the results and the hopes of this important committee.

A Summary

Therefore, the following extracts from the report of the committee, which presented for publication the original Cement Specification of the Am. Soc. for Test Mat., are most important and historically vital to the discussion of Mr. Force's paper. They are:

> These reports on uniform tests of cement and standard specifications for cement are the result of over six years' labor of a thoroughly representative body of experts, covering every field from the manufacturer to the consumer; they stand for the very best thought on the subject.
>
> The various committees are still in existence and will from time to time recommend such changes as are found by experience to be desirable, thus gradually perfecting the specifications as a whole.
>
> In the meanwhile by the adoption of these specifications a standard of excellence is set which will enable the manufacturer to concentrate his efforts in operating his plant so as to produce uniformly the grade of cement required and at a minimum cost to the consumer.

The Real Value of the Autoclave Test

It is with these vital words that one must deal in considering any suggested new accelerated or any other new tests. The evil having been pointed out, the cure having been arrived at after six years of work, it would be almost a crime at this time when three committees representing the best engineering thought of the American engineering community to say nothing of the international committee, are in existence and at work and are capable of considering all new methods—that any new test, deserving though it may be, should find its way into engineering practice or engineering thought without passing the scrutiny of the accumulated wisdom of the gentlemen who have given their time and their intelligence to the consideration of the whole subject of cement testing. Mr. Force's work is deserving of the highest consideration, and as a contribution to engineering knowledge on the *use* of the autoclave apparatus and of the results obtained therefrom, it has a field, as has any new discovery in the method of making briquettes or in the form of molds, but when a test which is but a repetition of the old Erdmenger test is stated to be the "autoclave test," and is defined by the writer as a *test* without a definition of the *test* itself, it may lead to confusion and misunderstanding and re-open in an inaccurate and unscientific way subjects long settled after many years of consideration and years of thought by regularly authorized bodies constituted for the purpose.

It is not the part of this journal to discourage investigations into the properties of cement or into the methods of testing cement, nor is it the proper part of this paper to advocate the interests of the consumer as against those of the manufacturer, nor those of the manufacturer against those of the consumer. This paper is interested in the best development of the cement industry and in the greatest development of good concrete for all purposes and for the safety of all work done with cement. It believes, however, that the discussion provoked by Mr. Force's paper will lead to the re-investigation of the old Erdmenger tests discarded by the Germans many years ago and will lead to comparisons of cements of various kinds tested under this method and it believes that the proper forum for the investigation of this as well as any other new tests is the forum constituted by the committees at work upon the subject. It believes that the reference of the paper to the Committee on Standard Specifications for Cement of the Am. Soc. for Test. Mat. is a proper and right one, and it believes that Mr. Force will be the first to co-operate with the committee in furnishing the additional information as to long time tests which his paper indicates he will have when another year rolls by. It believes, in view of the statement of the many speakers at the meeting as to the erratic character of the results under the so-called autoclave test that no desultory or "accelerated" determination of this suggested new test can be had, but that it will require deep thought, great care and a long time to arrive at a result that will command the respect and regard of the profession and the industry.

In the meantime, it hopes that neither consumers nor engineers will be led into the by-paths of untried tests and untried methods far from the standards established by those to whom the engineering profession has entrusted this serious and deep responsibility, and it knows that the hundreds of millions of barrels of cement used in great work under the present specification bear witness to the fact that "he who goes slowly will go surely" in a matter of this great importance.

* * *

A Tribute to an American Engineer

A well-merited compliment was paid to Richard L. Humphrey, President of the National Assn. of Cement Users, by the members of the Council of the British Concrete Institute. It took the form of the presentation of a bronze medal for the best paper read in the 1911 and the 1912 sessions of the Institute. Those who are familiar with this important treatise upon "Fireproofing" can well appreciate how much the honor was deserved.

The proceedings attending the presentation must have been most gratifying to Mr. Humphrey in the tribute paid to him, not only for the paper itself, but for his long devotion to the cause of cement and concrete. There are few men who have done as much faithful, painstaking, hard work in the preparation of specifications, in the examination of the scientific side of cement and concrete and in the presentation of these papers on these important subjects as has Mr. Humphrey. It is a fitting tribute to his good work that the British Institute has paid him this deserved compliment, which, in a way, fitly accompanies the beautiful silver statue of "The Concrete Worker" presented to Mr. Humphrey by the German cement manufacturers in appreciation of his services in planning their tour through the American cement works at the time of the International Congress of Testing Materials.

* * *

The Safety of Concrete Dams

Engineer Luiggi in a recent number of the *Annales de la Societe des Architectes et Ingenieurs Italiens*, writes very interestingly on dams for artificial reservoirs. After describing the disadvantages of earthen and masonry dams he advocates most strongly reinforced concrete for the purpose of reservoir construction. Beginning with the Assuaan dam on the Nile, the writer describes many of the more recent constructions in this country where impermeable diaphragms have been used, such as the works on the Cold Spring and recently on the Rio Grande river in Colorado, and comments especially upon the ideal type which has been used at Morena, near San Diego in California, and also at Relief in the Sierra Nevadas. "These dams," he says, "destroy all the fear of a destruction by earthquake, because the large body of dry masonry can separate and become displaced, but not disappear. The diaphragm can be torn and let the water of the reservoir through, the water going through the cracks slowly, and not in one great body, as is the case in masonry dams. No great destruction would be produced by such inundations as was in the case of the Johnstown and other similar disasters."

Concrete Fence Posts for Factory Inclosure

The following article illustrates how an industrial corporation is recognizing how much concrete is superior to wood for fence construction. In all new work and replacement, concrete posts of the same general dimensions as the former timber posts, are used. The panels are still of timber, although efforts are being made to develop a satisfactory concrete panel

The plant of the Michigan Alkali Co., manufacturers of caustic soda, located on the outskirts of Detroit, has been surrounded for a good manay years by a high board picket fence. The photograph shows the present fence. Beginning several years ago, concrete posts were cast to replace the wooden posts, the concrete posts being made in the same dimensions as the wooden posts which they replaced. As the fences were extended or repaired, concrete posts posts were used altogether.

At the present writing the Michigan Alkali Co. is casting several hundred new posts, and the accompany notes and photographs show in detail some of the interesting features of this work.

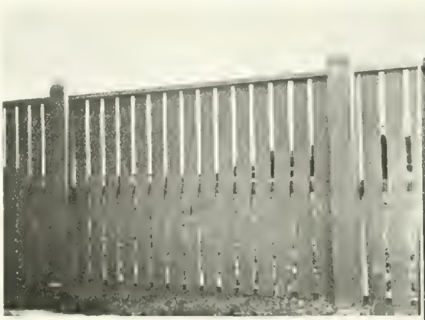


Fig. 1—General View of the Fence at the Plant of the Michigan Alkali Co. The posts are of concrete, the panels in between are of wood

The Molds Used

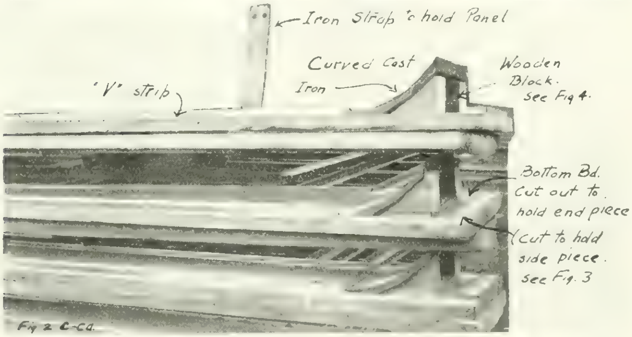


Fig. 2—The Bottom Boards Assembled Ready for the Side Boards and Yokes

Fig. 2 shows the bottom boards assembled ready for the side molds and the yokes. These bottom boards are shaped at the mill by running through a planer as shown in section in Fig. 3. As shown in Fig. 2, the bottom boards have a cast-iron curved segment at one end which is screwed to the board and held upright by wooden blocks. The chamfered corners of the post are made by using little triangular wooden srips.

In assembling the molds a bottom board is placed across a pair of horses by a carpenter and the side boards put into position, 2 in. lumber is used throughout. The yokes, of which five are used to each pole, are very ingenious indeed. They are cut as shown in detail in Fig. 5. The bottom notch comes directly under the bottom board, the bolt going through so that it fits snugly against the bottom board. The long notch in the yoke is as long as the width of the side boards plus the net thickness of the bottom boards so that the yokes fit snugly on to the forms. The notch shown at the top is cut so that the spacers or spreaders fit in there and when the bolt is tightened, are held rigidly in place.

This is especially valuable in keeping the spreader up off the surface of the concrete about 2 in., as the mold is filled, thus allowing the top surface to be floated and finished without any interference.

The curved pointed top is produced by a cast iron segment similar to the one used on the form facing it, and two pointed cast iron segments which fit in between the concave surface of the top and the bottom segments.

In placing the top curved iron segment a bar of iron is slipped through two holes bored in the front of the form and a little wooden wedge driven underneath this bar.

The entire idea of the form is to produce an easily handled and easily assembled unit form.

Erection of the Fence

The timber panels between the parts which complete the fence are held in place by three heavy iron bands ¼" x 2" x 12", projecting about 2 in. from the face of the post. These are inserted

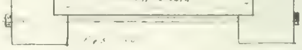


Fig. 5—Detail Section of Post and Mold

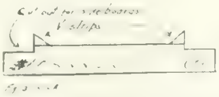


Fig. 3.—Sectional Sketch Showing the Way the Bottom Boards Are Shaped in the Planer

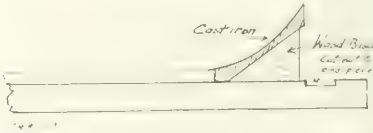


Fig. 4—Side View of the Bottom Boards Showing the Elevation of the Curved Segment

through slots in the molds. To allow the entrance of the wooden stringers a notch about ½" deep and 2" high is left in the face of the post. The top iron strap is placed horizontally at the lower part of the notch; the two other iron straps are placed vertically. In this way the upper stretcher of the picket panel rests on the top strap and is bolted to it. The other two stringers are bolted to the iron.

The concrete was mixed by hand in a mortar box and placed by shovelling from wheelbarrows. The posts are amply reinforced to withstand handling and any impact. After erection the concrete posts are painted with the same materials as the timber panels.

The construction department of the Michigan Alkali Co. states that they are trying to find a substitute for the wooden panels in between the concrete posts as timber is high in first cost and its maintenance is high.

In order to protect the valuable records of the government from danger by fire, Congress has made an appropriation for the installation of a modern system of auxiliary fire protection for three of the largest buildings occupied by the Dept. of the Interior in Washington. A committee has been appointed to investigate the relative merits of systems adaptable to the buildings of the Department and to prepare plans and specifications. All communications regarding the subject should be addressed to the Chief Clerk of the Interior Dept., Washington, D. C.

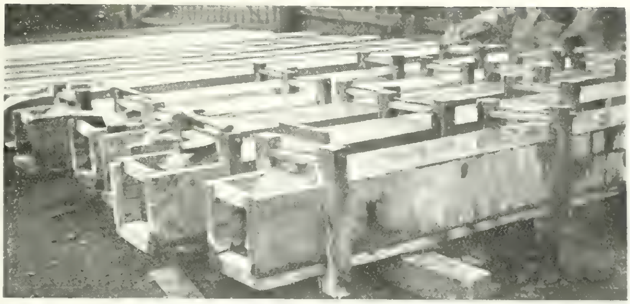


Fig. 6—Casting the Concrete Posts. This Shows the Arrangement of the Stringers and [illegible] Details in Fig. 5

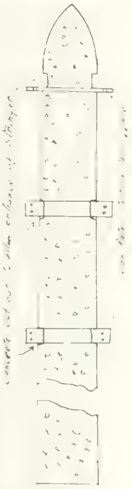


Fig. 7—Vertical Section of the Post Showing Arrangement of the Iron Straps

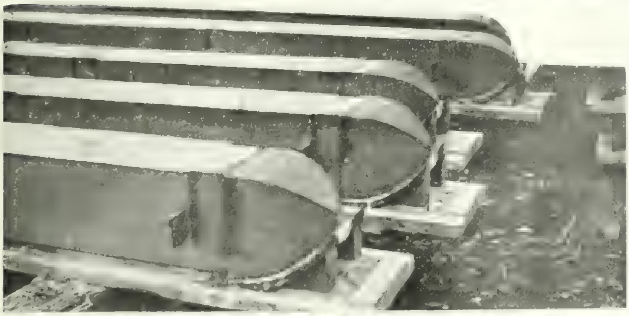
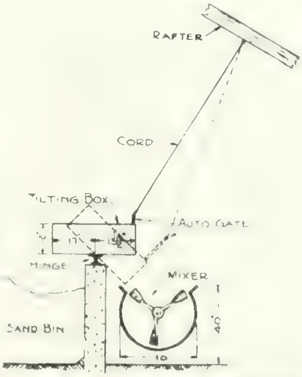


Fig. 8—[illegible] View [illegible] End of the Finished Posts

A Tilting Box As A Side Loader for a Batch Mixer

The accompanying sketch shows an ingenious rig used to load a small batch mixer. The mixer in use was an open dumping drum, paddle blades mixer, and the mixer in particular is being used in a concrete block plant.

The accompanying sketch shows in section the mixer, the sand bin wall and the sand storage bin. The box located on the bin wall is so arranged that it holds easily a definitely measured quantity of sand. The box in question was 12" high and 18" wide, so that per lin. ft. it held 1½ cu. ft. of material. The box was 32½" long inside, so that when full it held 4 cu. ft. With a sack of cement this made exactly a 1:4 mix.



Sectional Sketch Showing Arrangement of a Tilting Box as a Loading Hopper.

The sketch shows the ingenious way in which the end gate was arranged to open automatically as the box was dumped. The hinge was so arranged 17" from the rear of the box that it could be emptied very easily when required. A cord, fastened to the sliding end gate and to a rafter above, pulled the end gate up when the mix was dumped, allowing this to be dumped into the end of the mixer. When the box was tilted back to its horizontal position the gate slid down to close the box.

Such adoption of loading hoppers for mixers makes for more effective and accurate work.

The Chicago *Tribune* recently called attention to the great need of fireproof construction for Chicago hospitals. The building inspector asks that 60 be torn down and rebuilt with fireproof materials.

"The only absolute safeguard to lives of helpless patients," says the *Tribune*, "is to afford them the safety of housing in hospitals of fireproof construction. If there should be a disastrous fire the building department would be held responsible. We ought not to deal too leniently with charity that jeopardizes the lives of the beneficiaries."

After pointing out that there are 103 hospitals in the city, nearly 60% of which consist of brick buildings of wood interior construction and ranging from two to six stories in height, the statement is made that the conditions at most of these hospitals are such that additional stairs and fire escapes, as means of exit, will be inadequate in the case of a heavy or quick conflagration, due to the flimsy wooden interior construction.

Reinforced Concrete Slabs under Concentrated Loading*

BY A. T. GOLDBECK†

In carrying concentrated loads, such work as light highway bridges are required to do, the structural efficiency and economy of the concrete slabs depend essentially upon what width of the slab, transversely to the span can be figured upon as carrying the load. The following experiments indicate that a width, eight-tenths of the span, can be considered as active in resisting bending

Several years ago the U. S. Office of Public Roads expanded its engineering activities to include a limited amount of work in connection with highway bridges. One of its first efforts in this direction was to encourage local highway officials to replace the great number of unsafe and unsightly short-span wooden bridges and culverts with permanent structures of reinforced concrete. In order better to disseminate information concerning this subject, many typical designs were prepared, together with tables showing suitable dimensions and reinforcement for both slab and beam structures.

When the engineer is confronted with the design of a reinforced concrete slab, to be subjected to a concentrated load, his fundamental consideration is the width of slab that may reasonably be counted as effective in carrying the load. It is necessary for him to assume the value of what may be called the effective width of slab when using the ordinary theory of rectangular beam design, and since it is probable that this width varies with the percentage of longitudinal and transverse steel, span, depth, and kind of concrete mixture, it will be seen that the number of tests required to furnish a satisfactory basis for this assumption will be very large.

Description of Specimens

All specimens were made of concrete mixed in the proportion of 1:2:4, to a consistency ordinarily described as "quakey." The cement complied with the U. S. Government specifications for Portland cement; the sand was a fairly well graded Potomac river sand, and the gravel was clean, sound and well graded from ¼" up to ¾". One-half-inch plain round steel rods, having a yield point of 38,800 lbs. per sq. in. and a tensile strength of 73,000 lbs. per sq. in., were used exclusively for reinforcement. Compression cylinders, 8" in diameter and 16" high, were molded at the same time the slabs were made, and of the same concrete.

The slabs were molded on heavy oiled paper, laid on the floor of the laboratory. The center of the steel was placed 1" from the floor, so that the total depth of the slab was 1" greater than the effective depth. The present series of tests includes the specimens described in Table I.

TABLE I—DESCRIPTION OF REINFORCED CONCRETE SLABS

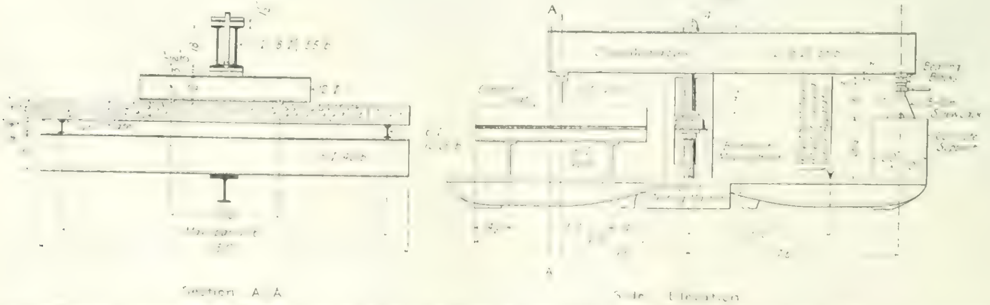
Slab No.	Dimensions, ft.		Depth, in.		Approximate Weight, lb.	Percentage of Steel.	
	Length.	Breadth.	Total.	Effective.		Longitudinal.	Transverse.
679	13	6	7	6	6830	0.77	....
705	9	7	5	4	3940	0.91	....
706	9	7	5	4	3940	0.91	0.41
730	9	7	6	5	4720	0.91	....
736	9	7	4	3	3160	0.60	....
737	9	7	7	6	5520	0.75	0.33

Within a few days after each slab was made, plates of brass ½" sq. and ⅛" thick, containing a small hole drilled with a No. 55 drill, were cemented to the top in carefully spaced rows. The drill holes in these plates were placed exactly 8" apart is order that they might be used in connection with an instrument designed to measure very slight changes in their spacing. Some of the reinforcing rods were likewise drilled with a No. 55 drill and the drill hole was protected from the concrete while pouring, by means of insulating tape and a cork. The cork and tape were later burnt out in order to expose the drill hole in the steel. Slab No. 679 was provided on the bottom with small cast iron blocks wired in contact with the rods and each block was drilled for deformation measurements. Measurements were taken both at right angles to the supports and parallel with them, in sufficient numbers to determine the magnitude and distribution of the deformation in each direction.

The Apparatus Used

The deformation measurements were taken in the concrete and steel by means of a strain gauge[1] of the type designed by H. C. Berry. It consists of a rigid frame carrying a fixed conical point at one end and a movable conical point at the other end. The motion of the movable point is multiplied five times by means of a bell-crank lever and its amount is indicated on a graduated dial. By very careful manipulation an accuracy of 1/10,000 in. in 8 in. may be obtained. In using this instrument, the conical points are simply inserted into the No. 55 drill holes and the dial reading is taken.

For measuring deflections, a special instrument was designed. It consisted of a surface testing dial reading to 0.001 in., mounted at the center of a white pine board, which was shod at the lower edge with grooved pieces of steel. While being used the board was placed on edge in the direction of the



Section A A

Side Elevation

FIG. 1—SHOWING ATTACHMENT TO GENERAL TESTING MACHINE FOR TESTING FULL SIZE BRIDGE UNDER CONCENTRATED LOADING, AND METHOD OF MOUNTING A SLAB

span and made to rest upon steel rods having rounded upper ends. These rods were cemented in a vertical position over the supports. A movable plunger actuating an indicator on the dial rested in contact with a drilled brass plate, cemented to the top of the slab at the center line. Deflection readings were taken at a number of places throughout the length of the slab.

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* An abstract of a paper presented before the 16th Annual Meeting of the Am. Soc. for Test. Mat.

†Testing Engr. Office of Public Roads, Washington

Loads were applied by means of a general testing machine of 200,000 lbs. capacity. The weighing table of the machine in use at the Office of Public Roads is fitted with long extension arms for testing narrow beams up to 16′ in span length. In order to investigate a large reinforced concrete slab in a machine of this type, it is secessary to mount the specimen transversely across one of the extension arms. For this purpose two 15-in., 42-lb. I-beams were supported on one of these arms. In testing slab No. 679, two 6-in., 12¼-lb. I-beams were laid across these, in order to serve as supports for the slab. For all other slabs, the 15-in. beams acted as supports. For applying the load, two 18-in. 55-lb. I-beams were used. They were bolted together and extended from the extreme end of the extension arms over the moving head of the machine to the center of the slab. One end of these I-beams rested on bearing blocks, which in turn were supported by a 15-ton screw jack, mounted on a concrete support. The other end—the end applying the load—rested on the slab to be tested. Loads were applied on the 18-in. I-beams by the moving head of the machine, through a 2-in. loop-welded eye; and by means of the screw jack the load applying beams were maintained in a horizontal position. It was necessary to counterbalance the weight of the slab and its supporting I-beams to prevent the overbalancing of the machine.

Method of Testing

The exact method of mounting the specimens indicated in Fig. 1 was slightly modified in order to obviate the danger attending the use of the rocking supports. It is probable that a very slight error has resulted, owing to the small drag of the supports, which tend to rock out of a vertical position, when the load is applied. This error, however, is inconsiderable. To insure uniform bearing, the specimens were lowered upon a soft mortar mixture placed on the I-beam supports, and this bedding was allowed to harden for one day before the slab was tested. Loads were applied on the slabs over a bearing area 6″ in diameter, and containing 28.3 sq. in. with the exception of slab No. 679, in which the bearing block consisted of one-half of a vitrified paving block having a bearing area of 18 sq. in. A complete set of deformation and deflection readings was taken for each increment of load applied.

Results of Tests

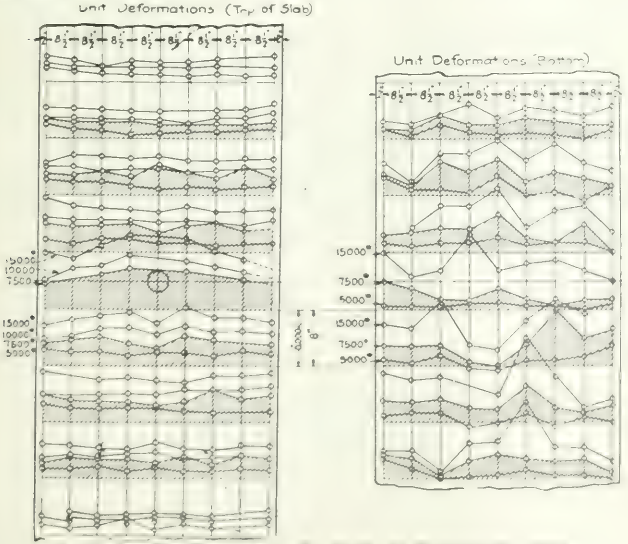
Some typical results of the deformation and deflection readings are given in graphical form in Figs. 2 and 3.[2] The ordinates to the curves of unit deformation show the amount of this deformation in various parts of the slab. The values plotted represent the mean unit deformations in gauge lengths of 8″, with the measurements taken at right angles to the supports. The base line of each curve marks the position of the line of brass plates between which the deformation measurements were taken. The position of the load is marked by means of a cross-sectioned circle. The curves of deformations which most nearly represent conditions, under the load causing a working stress at the center, are cross-sectioned, and on some of the plates curves are plotted, showing the unit deformations caused by loads both greater and less than the working load.

[illegible]

Slab No.	Span, ft	Effective Width, ft.		Ratio of Effective Width (from curves) to Span.
		From Curves.	$b = \frac{M}{\frac{f}{2}jkd^2}$	
705	6	5 25	4 66	0.9
730	5	5 5	5 0	1 1
	6	5.75	5 92	0.96
737	5	6.0	6.0	1 2
	6	7.16	5.25	1 2

In general, as might be expected, the greatest deformation occurred under the load, and as the supports are approached the deformations become smaller. The local effect of the load is very perceptible in producing deformation in the slab. Although the deformations at the sides of the slab are small, yet there is a very perceptible deformation, even at a distance of 4½′ on either side of the load, or over a total width of 9′. This indicates that even at 4½′ from the load the slabs investigated exerted considerable resisting moment. In a general way the maximum deformations in the same slab seem to be proportional to the loads applied. The deformations on the top of the slabs parallel to the supports showed a compression very small in magnitude.

An estimate of the width of each slab that might reasonably be considered as carrying the load—assuming a uniform distribution of the safe working stress over this width—was obtained from the curves of deformation. Since the resisting moment of a slab is dependent on the stresses in the top fibers, and these in turn are measured by the unit deformations of these fibers, the resisting moment is proportional to the ordinates to the curves of unit deformation at the center of the slab. If the unit deformation be considered as uniformly distributed, with a constant ordinate equal to the maximum ordinate in the actual curves of deformation, the width of the slab, having a resisting moment equal to that of the slab tested, may be obtained by equating the area of the the-



[illegible]

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[1] [illegible] Age, April, 1912.

[2] [illegible]

oretical rectangle of deformation to that of the actual curves of deformation. In this way the effective widths of the slabs given in Table II were obtained.

These values seem to indicate that the effective width of the slab hovers in the vicinity of the span length. This cannot be stated as a general proposition, for doubtless factors other than the span length, such as depth, percentage of reinforcement, etc., have influence on the effective width. The values given above are merely approximate estimates and are not exact. To obtain correct values for the effective width, it would be necessary to have the slab of such a width that the deformations vanish at the sides, and in the slabs tested this is not the case. Moreover, as before stated, many more tests will have to be performed before any definite conclusion can be drawn regarding the influence of all of the variable factors on the stress distribution. It is interesting to note that when the ordinary straight-line formula for resisting moment ($M=f^c jkbd^2 \div 2$) of a rectangular reinforced concrete beam is used, and the concrete is considered as governing this resisting moment, the effective width of slab obtained, when the modulus of elasticity of the concrete is taken at 2,000,000, checks in most cases with that obtained from the curves. These widths are given in the second column of Table II under "Effective Width," and were calculated using values for f^c corresponding to the maximum unit deformation under the load, taken from the cross-sectioned curves which represent very closely the conditions that obtain under working loads.

The curves of unit deformation on the bottom of slab No. 679, shown in Fig. 2, are of principal interest in showing that it is almost useless to attempt to obtain the stress distribution and effective width from readings in the steel. It will be noted that great irregularities occur in these curves. Where peaks in the tension curves occur, it was discovered that cracks had formed in the concrete within the spaces over which those particular measurements were taken, and indicate a large stretch in the vicinity of the cracks. There is a much smaller stretch on each side of the cracks where the concrete assisted the steel in tension.

Curves of Deflection

The curves of deflection are of principal interest in showing the shape assumed by the center line of the slab parallel to the supports when the loads are applied. As in the case of the deformation curves, the deflection curves show the local effect of the load in deforming the slab. The maximum deflections for the different loads on the same slab seem to be approximately proportional to the loads applied, when the loads are not excessively large.

Maximum Central Load at Failure

The maximum loads applied to the centers of the slabs at failure are given in Table III.

TABLE III—CENTRAL LOADS AT FAILURE

Slab No.	Span, ft.	Bearing Area, sq in.	Central Load, lb.
679	11.5	18	21 500
706	3	28 3	42 800
730	6	28,3	24 700
736	6	28 3	7 560
737	6	28.3	34 200

NOTE: See Table I for description of slabs.

The shape of the cracks on the bottom of each slab is shown in Figs. 4 and 5. Slab No. 679, although without any transverse steel whatever, cracked almost in a straight line across the center from side to side, and failed probably by tension in the steel. No. 706, a wide slab tested on a short span, failed, as might be expected, by shear. The bearing cylinder, 6″ in diameter, punched a hole in the center of this slab at failure, and the concrete was badly cracked under the load. The cracks extended on either side of the load over a width of about 5 ft. No. 730, tested on a 6-ft. span, failed probably by tension in the steel, and unlike No. 679, two diagonal cracks were formed extending over a width of about 5 ft. No. 736 also failed by tension. It was the thinnest slab tested, and in addition to the diagonal cracks, others developed at right angles and parallel to the supports. No. 737, like No. 730, and notwithstanding the fact that it was reinforced transversely with 0.33% of steel, developed diagonal cracks, extending in this case over a width of about 6 ft. The width over which these tension cracks extend in all of the slabs tested is very instructive and is indicative of

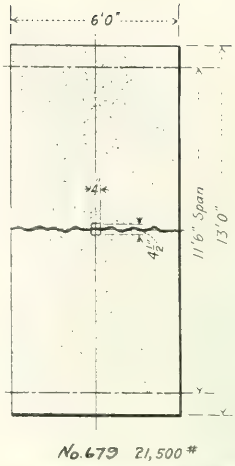
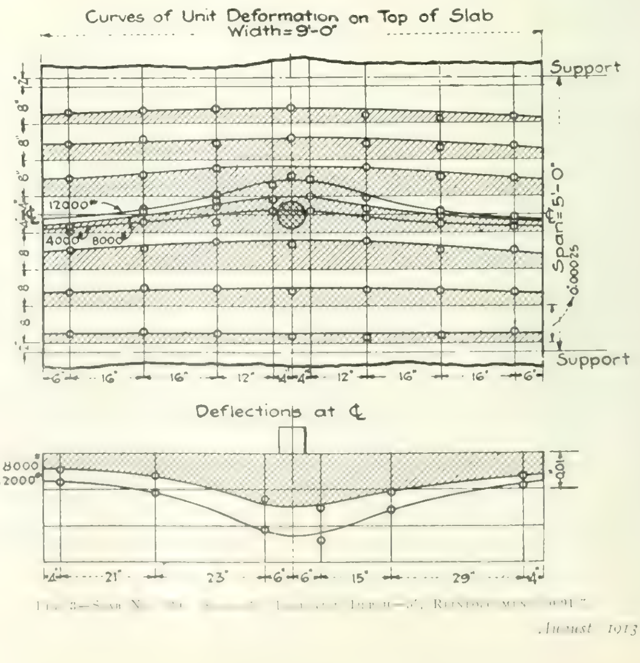


FIG. 4—BOTTOM OF SLAB AFTER FAILURE SHOWING SHAPE OF CRACKS


Curves of Unit Deformation on Top of Slab

Deflections at ℄

FIG. 3—SLAB NO. [illegible] DEPTH=5", REINFORCEMENT [illegible]

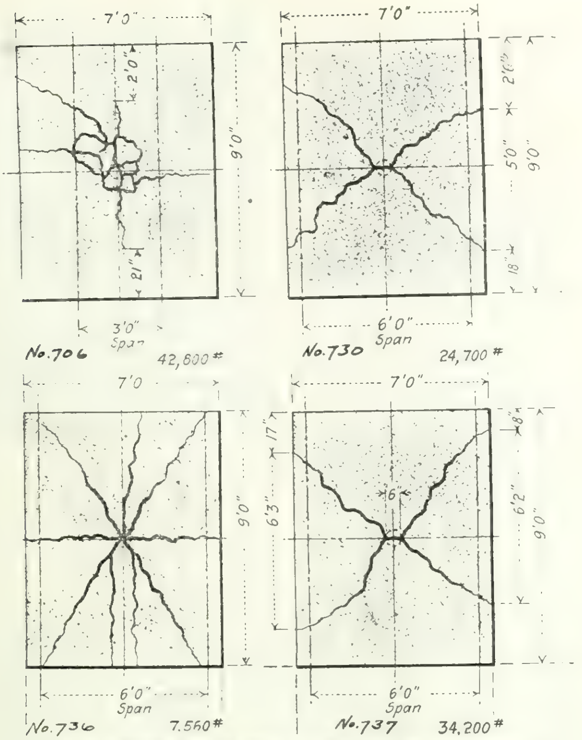


Fig. 5—Bottom of Slabs After Failure Showing Shape of Cracks

the width over which the bending moment was most largely resisted at failure. Perhaps it is significant that in the cases of Nos. 706, 730 and 737, the widths over which the cracks extend correspond reasonably well with the calculated effective widths under working loads.

Conclusions

No definite conclusions can be safely drawn from the tests thus far made, but the data collected are useful in indicating that in slabs of the kind described and of 3-ft. to 6-ft. span length, the concentrated central load might quite safely be considered as carried by a width of slab equal to not more than eight-tenths of the span length. Detailed conclusions are not warranted until more tests are made. The specimens, on account of their size, are heavy and unwieldy; their testing is very laborious and consumes time; and it is therefore earnestly hoped that the solution of the problem will be hastened by the co-operation of other investigators in this field.

The MacArthur Concrete Pile & Foundation Co., N. Y. C., has been awarded the contract for the complete foundation for the new Hartford City Gas Light Co. retort buildings, Hartford, Conn.

The Action of Various Substances on Cement Mortars

The paper presented before the sixteenth annual meeting of the Am. Soc. for Test. Mat. by Richard K. Meade,* describes a series of experiments which have extended over the past five or six years and which were conducted to determine the effect on concrete of the salts found in ground waters. The salts found in the West, which are generally called "alkali salts" are mainly sodium chloride, magnesium sulphate, calcium sulphate, sodium sulphate and sodium carbonate.

The cement specimens used in this series of tests, were briquettes all made of a 1:3 mixture, using a normal Lehigh Valley cement and standard Ottawa sand. After hardening 28 das. in air they were immersed in solutions of these various salts for various periods. The paper presents in detail tables showing the action of these salts on the cement briquettes and the chemical analyses of the constituents of the briquettes after immersion.

In investigating the action of sea water on concrete, Mr. Meade experimented with barium chloride and barium carbonate to determine what action they had in helping cement resist sea water. These are ground finely and mixed with cement. Barium chloride was added in the proportion of 2% of the cement and barium carbonate to the extent of 2% and 5%. The following table shows the action of magnesium sulphate solutions on cement mortars which contained barium compounds.

The use of iron oxide in cement which is exposed to sea water was also tried but without very good success. Other experiments covered the value of using various waterproofing materials in the cement mortar to be exposed to sea water action. The complete results of these experiments are presented in the paper in detail.

The paper also reports experiments made to determine the effect of sulphuric acid in dilute solution on concrete surfaces and in general the action of lubricating oils on concrete surfaces. The paper is of interest and value in summing up concisely a wide range of experiments.

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*Cons. Engr., Baltimore.

Table I.—[illegible]

Age in Solution.	Tensile Strength, lb. per sq. in., after immersion in					
	Magnesium Sulphate.	Magnesium Chloride.	Calcium Sulphate.	Sodium Sulphate.	Sodium Chloride.	Sodium Carbonate.
0 days[1]....	219	219	219	219	219	219
7 days.....	268	245	227	257	236	225
28 days......	272	300	300	331	268	277
3 months.	287	315	[illegible]	[illegible]	299	324
6 months..	196	202	314	378	287	320
1 year.....	Disintegrated	115	209	271	310	337
2 years...		Disintegrated	Disintegrated	141	325	360

[1] The briquettes were aged 28 days in air before immersion.

Table II.—[illegible]

Age in 1-per cent Solution of Magnesium Sulphate.	Tensile Strength, lb. per sq. in., of briquettes containing		
	2 per cent of Barium Chloride	2 per cent of Barium Carbonate	5 per cent of Barium Carbonate.
0 days[1] ...	181	113	166
7 days......	...	221	257
28 days	213	246	346
3 months...	306	311	316
6 months..	265	201	271
1 year.....	146	Disintegrated	Disintegrated

[1] The briquettes were aged 11 days in air before immersion.

Modern Methods in Track Bed Construction

A concrete base, steel cross ties and efficient equipment produce interesting results

Street railways in the U. S., especially in our larger cities, are called upon to build a track sub-structure which will withstand the hardest kind of wear. The constructing engineers of these companies have long ago realized that it was in no way economy to use anything but the best materials and the best methods, and we find now that the American street railways in their track construction are using the best and most permanent structure possible.

Concrete, of course, is used very largely, and it is now practically the material universal as a base in track construction. The accompanying illustrations show not only a very interesting form of track construction by the Cleveland Railway Co., Cleveland, but also a most effective use of well designed equipment to meet the requirements.

In the construction of the track the excavation is carried to a depth of about 24 in. below the top of the rail and a light steel tie, weighing 14½ lbs. to the ft., is used. These are bolted to the 95-lb. rail and held in accurate position by wooden blocks.

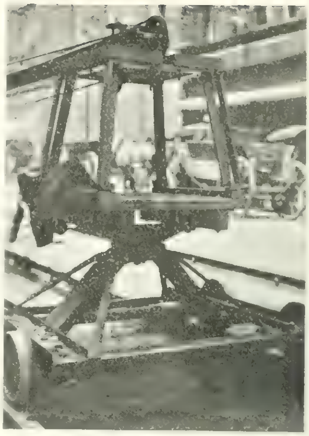
Around these cross-ties and up to the base of the rail concrete is placed, and the accompanying illustrations show what efficiency this equipment develops in handling road bed construction. Interesting features are the design, construction and operation of the small 14-cu. ft. mixer[1]. The general arrangement of the mixer is shown in Figs. 1 and 2. The drum, mounted transversely on a narrow channel iron frame, is carried on solid iron standard type car wheels.

The entire arrangement of the mixer is tandem, as it were. The loading chute is to the rear and is long and narrow, and in front of the drum is a boom, a 30′ 6″ I-beam, on which travels the distributing bucket. The machine is so designed that it is very little wider than the track on which it runs, so that it can be used right down a city street without interfering to any great extent with the traffic.

The interesting feature of the equipment used on this work is the fact that the front end of the boom is supported on an outrider as shown. This outrider or carriage, which is shown in detail in one of the illustrations and also in the sketch, is a carriage mounted on four wheels and furnishes a point of support easily moved.

The Distributing Bucket

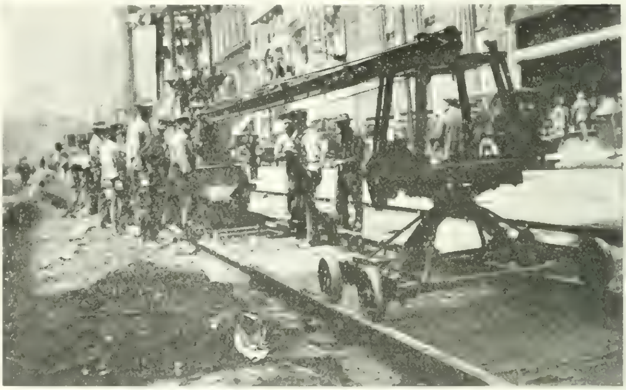
The bucket used to distribute the concrete is well arranged and works efficiently. This is a bottom-dump bucket and the bottom is formed by folding leaves which open downward. Instead of being controlled by exterior arms and levers, these leaves are simply hinged and held in place with tie rods inside the bucket and pulled upward and downward by a toggle arm. The arrangement is shown in the sketch, Fig. 4.



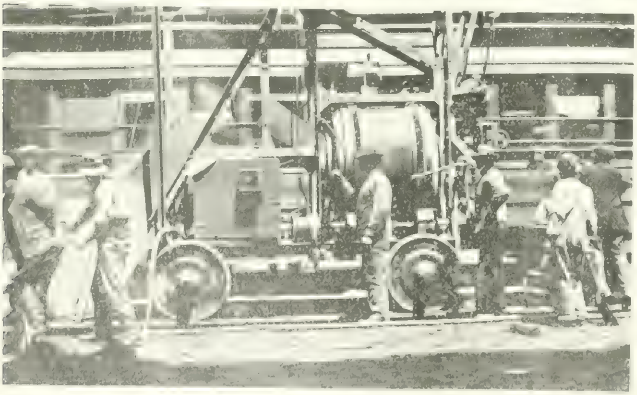
[illegible]

This toggle arm for closing the bucket is so arranged that while the bucket can be carried out on the trolley as far as desired, yet the first pull of the cable in bringing the bucket back toward the machine shoves a little shoulder *s* against the arm *a*. This throws the supporting bracket *c* over the center and the closing rod *d* drops, opening the bottom leaves of the bucket. After the bucket is dumped and returns to a position under the chute of the mixer, a trigger *t* strikes the arm *b* and thows it back to its original position. This mechanism operated rapidly and efficiently when it was under observation. The bucket starts out from the mixer, gets to the desired point and seems to dump immediately. The toggle arm locks and unlocks very much like gates on elevated or subway trains. The arms which support the bucket are shown at *c* and *f*.

As to the detailed operation of the work, the following force was being



[illegible]



[illegible]

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[1] [illegible]

used at the time these notes were taken: 6 men in front of the mixer shoveling the concrete into place under the ties and rails and puddling it with their shovels; 2 men at the levers; 10 men behind the mixer shoveling gravel into the loading hopper; and 3 men carrying up cement from a supply car situated about 150 ft. from the mixer. There were also two foremen.

In order to facilitate the work of the men behind the mixer as they step forward with a shovelful of gravel, a large platform is slid along the rails immediately behind the mixer.

The entire equipment is moved back a few feet more than the length of the boom about every six or seven batches; the bucket spots the concrete quite accurately and for the last batch next to the mixer the bucket is run empty out on the boom and the concrete is dumped directly into place. The motor on the mixer is situated in a steel housing. The power is furnished by trolley. The mixer is auto-traction, and is driven by a sprocket and chain on one of the axles.

An old fare register fastened to the engine housing with a cord convenient to the operator's hand keeps track of the number of batches run. The operator "rings up a batch" every time the mixer is loaded. At eleven o'clock when the mixer had been running 4¼ hrs. the indicator showed that 122 batches had been run. Concrete was a 1:6 mix, using gravel. C. H. Clark, of the construction department of the Cleveland Railways Co., believes that American practice is going to extremes in wet concrete, and in the concrete on this work a mix with a quaking consistency was uniformly used.

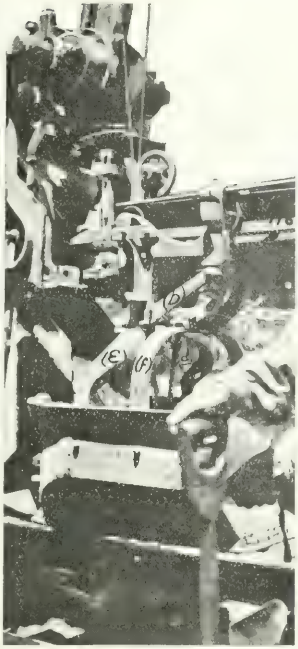


Fig. 3—Detail Showing the Bucket Dumping Mechanism

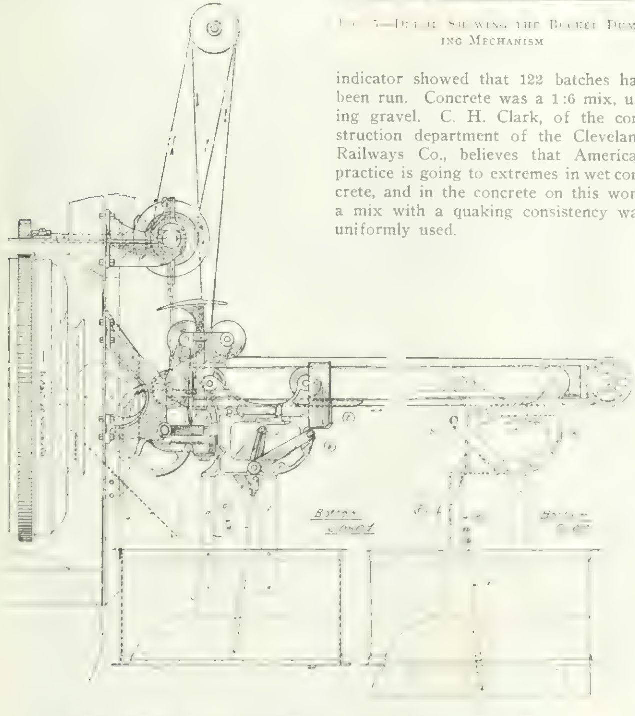


Fig. 1—[illegible]

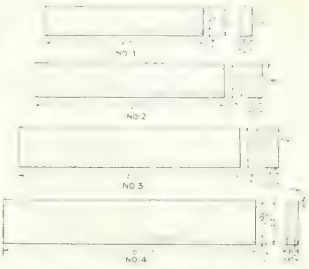
At the left is shown the bucket [illegible]. When the bucket [illegible] the trigger t intercepted the arm b, and a is revolved over its center, pulling up c and closing the bucket. At the right, the sh[illegible] s is revolved to strike a, throw it over its center and dump the bucket

Concrete Timbers for Mine Use

A timberman used to working with wood and able to judge with fair accuracy the proper size of timber for supporting any one piece of ground is apt to be rather at a loss when called upon to judge the amount of concrete necessary for the same job. A recent issue of *Eng. and Mining Journal* presents a brief article by C. G. Mason, a mining engineer, who, in order to guide the timbermen in such work, designed standard concrete beams and specified the timbers to which they would be equivalent in strength. The timbermen were thus able properly to proportion the beams and distribute the reinforcement and to select the dimensions equivalent to the timber which their judgment selected for the job in hand.

Beam No. 1, in the accompanying sketch, contains four 1¼-in. wire ropes spaced as shown. It is equivalent to a timber 10" x 16" by 10'.

The uniform load for either timber or beam is assumed at 2,275 lbs. per lin. ft., thus allowing a safety factor of 4. Longer timbers or beams of the same section would have the safe load decreased, this being for a 10-in. x 16-in. by 16-ft. beam about 900 lbs. per lin. ft.



Unit Concrete Beams for Mine Work

If it were necessary to withstand a running load of 2,275 lbs. per ft., the depth of section would be increased for the increasing spans and the reinforcement added to. Thus for a 12-ft. span loaded at 2,275 lbs. per ft., beam No. 2 would be used. This contains five 1¼-in. reinforcing ropes; for a 14-ft. span, beam No. 3 would be used, containing six 1¼-in. reinforcing cables; and for a 16-ft. span, the dimensions of beam No. 4 would be proper, this design also including six 1¼-in. cables.

The material used in the reinforcement was discarded hoisting rope. It was found that there was no shearing of the bond between the cable and the concrete, as the hoisting operation had taken all the stretch from the cables, making them as efficient as bars.

California is active in concrete highway work. The state highway, north of Fresno, has been completed over a distance of more than 12 miles.

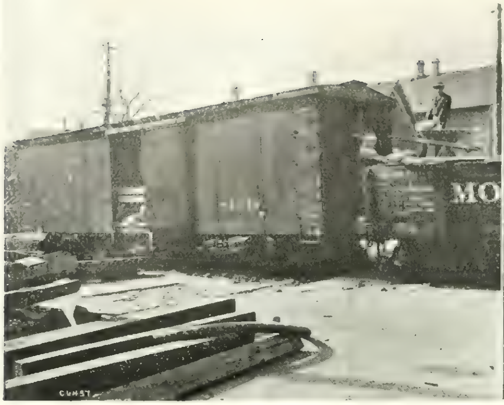


FIG 1—UNLOADING SACKED CEMENT THROUGH END DOOR C. M. & ST. P. TRACK ELEVATION

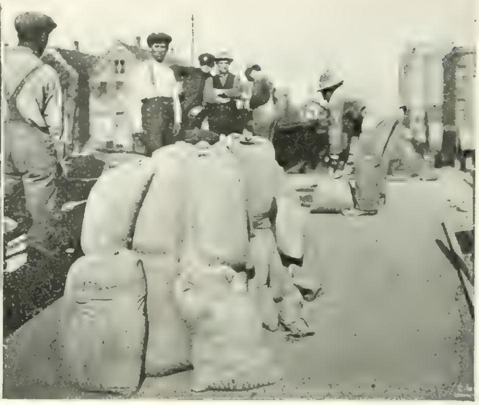


FIG. 2—CONGESTION ON MIXER PLATFORM DUE TO ACCUMULATION OF SACKED CEMENT, C. M. & ST. P. TRACK ELEVATION

Economical Construction With Bulk Cement

J. H. LIBBERTON

When cement is shipped in bulk, it packs down so closely that it can be walked on without sinking in, and has an angle of inclination of 90°. On this work the builders tried cement in bags and bulk, and bulk cement saved them $.1139 per cu. yd. of concrete

The Chicago, Milwaukee and St. Paul Ry. has recently developed the use of bulk cement in a most interesting way, and is finding that the handling of the material in this form results in a lower cost per yd. of concrete and in a greatly increased labor efficiency. When the railroad began, this spring, to elevate the tracks along Bloomingdale Rd., Chicago, the construction of the retaining walls was begun with sacked cement. One track only was available for construction purposes, so it was found necessary to couple up the mixer car with the cement and gravel cars, and place the cement car at the opposite end of the train. The cement was handled through the end door of the car as shown in Fig. 1, and then wheeled the length of the train on runways along the gondola cars containing the sand and stone to the charging platform on the mixer car. Here it was piled as shown in Fig. 2, until needed. Fig. 2 also shows a condition that was found to occur with annoying frequency while sacked cement was being used. In the illustration may be seen a number of laborers standing idle until the necessary number of sacks of cement can be emptied into the mixer. It also shows the unsatisfactory conditions on the charging platform due to the fact that a considerable area was necessarily occupied by sacks of cement and empty sacks, thereby interfering with the proper passage of the wheelbarrows containing the sand and stone. Fig. 3 shows the appearance of the charging platform after the use of bulk cement was begun. The entire platform was free and unobstructed, the barrows of sand, stone and bulk cement passed around the hopper in orderly routine, each one being emptied in the same way and in the same time, and the wheelers passed directly back in regular order without any delays or interference.

Bulk Cement Makes for Economy

A trial was made of a couple of carloads of bulk cement, and the advantages of using the material in this form were so clearly demonstrated that the job has been conducted with bulk cement ever since. As nearly as may be estimated by an outsider, there is a saving of $.0867 per yard of concrete due to the elimination of sack losses and the expense of counting, bundling and shipping empty sacks, and an additional

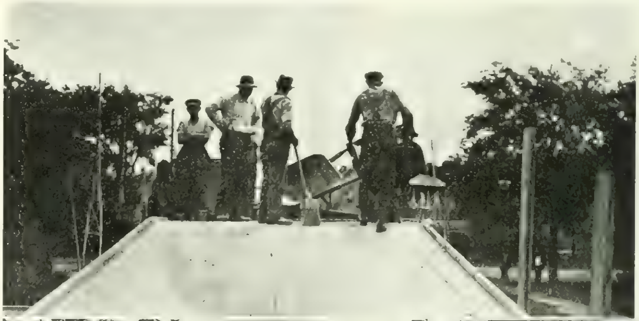
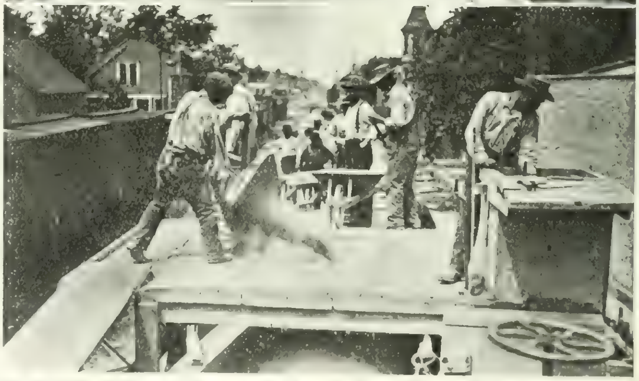



FIG. 3 (ABOVE)—IMPROVED CONDITIONS ON MIXER PLATFORM THROUGH USING CEMENT IN BULK. TAKEN FROM SAME RELATIVE POSITION AS FIG. 2

FIG. 4 (BELOW)—LABORER DUMPING BARROW OF BULK CEMENT INTO MIXER SHOWING ABSENCE OF LOSS OF CEMENT THROUGH BEING CARRIED AWAY BY WIND

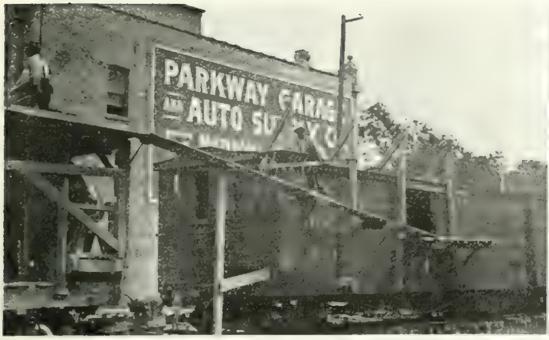


Fig. 5—Interchangeable Wooden Brackets for Carrying Runways Up Which to Wheel Bulk Cement

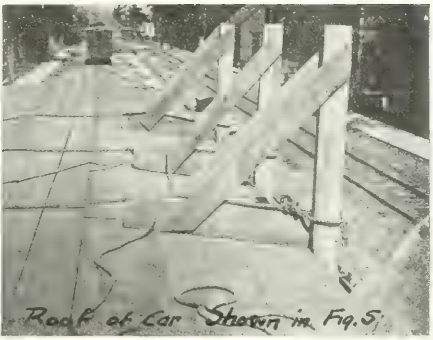


Fig. 6—Labor Saving Methods of Holding Brackets to Cement Car by Means of Rope and Hooks, the Entire Time Necessary for Attachment Being Five Minutes

saving in direct construction labor of $.0272 per yd., making a total saving of $.1139 per cu. yd. of concrete. The handling of bulk cement has been found to be very simple, just as simple, in fact, as the handling of sand. By the time a shipment has reached destination the cement has packed down so closely in the car that the men can walk on the surface of the cement with perfect ease and without sinking into it to any appreciable degree. As it stands in the car the cement has an angle of inclination of practically 90°, so it is a very simple matter to shovel it into the wheelbarrows. There is no more dust in the car than there would be if sacks of cement were being loaded onto trucks, while Fig. 4 shows how little dust there is when a barrow load is dumped into the mixer. It is interesting to note that this picture was taken on a day when there was a good stiff wind blowing, but, thanks to the wheelbarrow, which acted as a windshield, there was actually less dust allowed to escape into the air than there would have been had the cement been emptied out of sacks.

Figs. 5 and 6 show an interesting arrangement that was devised by one of the foremen on the job to facilitate handling bulk cement from the car to the mixer. When the use of bulk cement was begun the cement car was placed next to the mixer car in order to decrease the distance that the cement would have to be wheeled, and runways were built to the car door from the charging platform. These runways were carried on uprights that rested on the ground and supports nailed to the side of the car, so that the structure practically had to be rebuilt every time a new car was set. The foreman conceived the idea of carrying the runways on brackets hung from the car roof as shown in Fig. 5, so that it is now a matter of a very short time to place the runways on a new car. Fig. 6 shows how the brackets are hung from the top of the car and secured against sliding off by means of ropes and hooks that fasten under the eaves on the opposite side of the car. When the work of unloading begins, the top of the cement is practically on a level with the lower end of the runway and as the work of unloading progresses additional runways are placed inside the car, running from either end up to the center, so that the work of wheeling the cement out and up to the charging platform is comparatively easy. As the cement is now handled, a shoveler is placed in either end of the car. The shovelers load the barrows for the wheelers, taking from 45 sec. to 50 sec. to load a barrow. This is practically the same time that was required in order to load and unload wheelbarrows with sacked cement, so that no labor is lost in the handling of the material, while under present conditions a saving is made of the wages of the men who were formerly stationed on the charging platform to handle, untie and empty sacks, and to take care of the empty sacks.

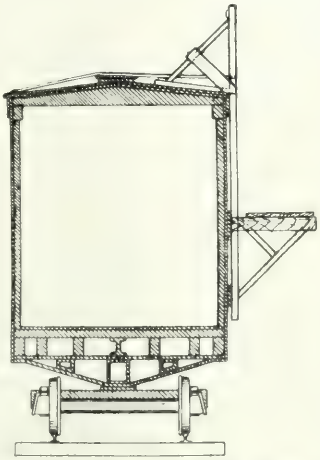


Fig. 7—Sketch Showing Bracket for Runway on Side of Cement Car When Handling Bulk Cement

For these, use second hand 2" x 6" for [illegible] and 2" x 6" for brackets [illegible]. Manila [illegible] lashing and [illegible].

Flat Roof Construction

In the recent development in concrete houses at Nanticoke, Pa., which has been described in past issues of Concrete-Cement Age, flat concrete roofs were used throughout. In the construction of these a flat concrete slab was placed, being poured on steel panel plates. This was graded to a pitch on the upper surface by applying a cinder and cement concrete fill. On top of this a tar and felt roof was placed.

Wooden strips were nailed to the under side of the roof and to this the lath and plaster were applied. These roofs were entirely waterproof even before the composition roofing was placed, but as a precaution against shrinkage joints or cracks, tar and felt were used. So far the results have been satisfactory.

It has been found in building such flat roofs that if large casement windows are placed near the underside of the roof, so that the hot air can easily escape, there is little difficulty from excessive heat in hot climates. In these climates it has been necessary to fur down the roof to prevent condensation in cold weather.

Puzzolan cement was manufactured in 1912 at three plants in the U. S.—at North Birmingham, Ala., Struthers, O., and Sharon, Pa.—"Collos" cement at Buffalo, N. Y. The output of puzzolan and "Collos" cements in 1912, as stated in a recent bulletin issued by the U. S. Geological Survey, was 91,867 bbls., valued at $77,363, compared with 93,230 bbls., valued at $77,786, in 1911. This represents a decrease in quantity of 1,363 bbls. and a decrease in value of $423. The average price per bbl. of these slag cements in 1911 and 1912 was 83.4 cts. It is remarkable that in 1912 the average price of slag cement was, perhaps for the first time, 2.1 cts. higher than that of Portland cement. One reason for the present high average price of puzzolan cement is that a considerable quantity of this product is of a light color and is considered to be non-staining and consequently sold at a much higher price than ordinary gray or brown cements.

Fireproof Construction in Mines

Engineers who have made a study of mine construction development know that fire-resisting structures are essential for underground work.

In a recent address before the Mining and Fuel Conference, at the Univ. of Illinois, Urbana, Ill., Herbert M. Wilson, of the U. S. Bur. of Mines, stated that mine fires are more frequent of occurrence and more destructive of property than are mine explosions. Mr. Wilson calls attention not only to the recent mine disasters which took a heavy toll of life, but he also notes the almost incredible loss by fire. There has been destroyed $25,000,000 worth of coal in the last 50 years in a mine fire still burning near Summit Hill, Pa. The mine fire at Cherry, Ill., and the Pancoast mine fire near Scranton, Pa., have recently been most destructive to life.

But more shocking than all, Mr. Wilson said, is the fact evidenced by the records that the greater number of these disastrous fires had their origin in trivial causes and, had proper safety regulations been in force, proper means been at hand for fighting fires, and reasonable practice and enforcement of the rules been had, these fires might have been quickly extinguished.

There has been developed in recent years a large volume of detailed information concerning methods and costs of permanent underground construction. Shaft lining should unquestionably be of fire-proof construction. The construction may be of brick, of monolithic or of reinforced concrete, or of structural steel backed by steel lagging or reinforced concrete slab or curtain wall, as local conditions, availability of materials and cost may indicate. Numerous admirable examples are available to the designer for shafts of circular, elliptical, and rectangular cross-section. These have been constructed in the metal mines in Nevada, Montana, Michigan and elsewhere, as well as in coal mines from Colorado to eastern Pennsylvania.

It will be a long time before wooden mine timbers are displaced to any appreciable extent by those of metal or reinforced concrete, yet the endeavor should constantly be to bring about this substitution, not only on account of greater protection from fire, but also because of greater permanency in construction and consequent ultimate less cost.

Of all the elements in the mine, the stable or the underground engine room should demand first attention. Several examples of excellent and cheap fire-proof construction in stables are to be seen in the coal mines of Pennsylvania, and elsewhere.

There is also a large field for experimental work in the design and construction of shaft and main haulage ways in concrete, the cost of which shall be kept at a minimum by the use of local mine rock and refuse as aggregate. Where considerable pressure is to be resisted, the best materials, mixed and laid in the most approved manner, are essential. Nevertheless, there are many mines where the essential is rather protection from seepage and inflammability, and where a minimum of compressive strength will suffice. Under such circumstances mine rock and other mine waste, sand or other fines locally available may greatly reduce the cost of material.

Low Value Concretes for Mine Work

The following compressive tests were made by the engineers of the Bureau of Mines on large-sized cubes of concrete made with mine rock, culm, ashes, sand, and gravel gathered in and about the anthracite mines of Pennsylvania. The proportion of cement used was very low in order to secure results on the cheapest mixture. These tests are compared with the best average results procured with rich concrete of furnace cinders and the best river sand and gravel, viz.: 1 cement: 3 anthracite cinders: 6 breaker refuse, 425 lbs. per sq. in.; 1 cement: 7 anthracite culm, 430 lbs. per sq. in.; 1 cement: 3 sand: 7 breaker refuse, 455 lbs. per sq. in.; 1 cement: 3 sand: 7 mine rock, 594 lbs. per sq. in. These results are comparable with: 1 cement: 2 sand: 5 cinders, 2,300 lbs. per sq. in.; and 1 cement: 2 sand: 4 gravel, 4,800 lbs. per sq. in.

With proper preliminary designing, it may be possible to keep in stock a few permanent forms for molding concrete. With such forms, shafts and tunnels can be cheaply constructed after the manner in which concrete sewers and water supply tunnels for cities are now built. There are abundant published data regarding the cost per lin. ft. of permanent and non-inflammable shaft and entry lining, showing, in many cases, that in a period of say 10 yrs. or 15 yrs. such lining is measurably cheaper than timber lining which may have to be renewed several times in the same period.

Probably no portion of a coal mine should be so carefully constructed as stoppings and overcasts. Here concrete has the advantage over timber, because of the less resistance to air-currents and the great importance of having them fire-proof.

Permanent Mine Timbers Essential

With mine timbers, as with shaft and entry linings, there are many excellent examples reported in detail where steel and where reinforced concrete have been used to replace wooden timbers. The mine timber problem is one of the most urgent confronting the mine operator. The forests of the U. S. are rapidly disappearing and the cost of timber is rapidly increasing until a point has been reached for many forms of construction where in those portions of the country most distant from timber resources either steel or reinforced concrete is cheaper even in first cost. In many wet mines wooden timbers have to be renewed every three years. Steel and concrete timbers may last indefinitely. Wooden sets, according to their dimensions, may cost, in place, $10 to $30, more or less, though there are records of steel sets costing about the same sum under similar conditions, whereas after a period of 15 years the permanent timbering will have cost one-third or one-fourth the price of the wooden sets. Reinforced concrete, especially when laid in place, is not well adapted to mine timbers because of the difficulty in placing forms and pouring, and the slowness in setting and in developing maximum resistance. Such timbers have, however, been satisfactorily molded and seasoned in required lengths in the open and then conveyed underground and placed much as are wooden timbers.

There is every reason to anticipate with confidence that the time is rapidly approaching when, due not only to an awakened public sentiment demanding greater safety in mines, and in some measure also because of the greater safety demanded by the enactment of Workmen's Compensation Laws, but more especially because of the relatively increasing cost of wooden timbers, as compared with metal and concrete and the greater permanency of the latter, fire-proof construction within our mines will rapidly supersede the more prevalent inflammable construction.

Painting Concrete Surfaces

At a recent meeting of the Canton Builders' Exchange, Canton, O., Geo. H. Gresser addressed the meeting on the subject of painting concrete surfaces. In discussing in general some of the salient features of this problem and indicating past failures in the use of oil paints, Mr. Gresser points out the present success of the specially prepared cement paint, which is now a standard material on the market.

These paints, Mr. Gresser stated, must not be put on over damp surfaces and will cover on the average about 200 sq. ft. to the gallon, one coat. The materials in general give a flat finish and add to the cost of the building about 35c to 40c per sq. yd. of surface painted. A good deal depends upon the surface finish of the concrete as the cost of labor and materials run up rapidly with stucco and rough-cast surfaces.

In painting interior walls, Mr. Gresser points out the necessity of taking the precaution of applying an interior dampproof paint before putting on the surface paint, and he closes with an urgent appeal to contractors in general to investigate this field carefully as the possibility of surface painted concrete buildings opens up a big line of work.

Through Fire and Flood at Dayton

BY WM. WALTER SMITH

A reinforced concrete building in the heart of the flood and fire-swept district of Dayton remained not only structurally intact but became a haven of refuge for over 300 people

Building No. 1 of the Beaver Light and Power Co., Dayton, O., was subjected to an unusual and simultaneous test of fire and flood in the destructive flood in that city in the latter part of March. This structure is of reinforced concrete throughout and successfully withstood the double test. It not only stopped the conflagration, which threatened to destroy Dayton at a time when the city was utterly helpless, but was also the means of saving the lives of 300 people, of whom 75 were women and 15 were babies.

The Beaver building is located on filled ground and in what is said to have been the old channel of the Miami river, previous to 1866. The course of the river was lengthened and the stream was thrown nearer to the north bluffs in order to increase the business area of the city. Consequently, when the levees broke above the city, the waters raced over the old and shorter course until the flood was 14' deep at this structure. So strong was the current that it removed not only the light "macholite"[1] partitions in the first floor and basement, but also carried out the stock of the several concerns occupying space there. The strength of the current may be judged from the fact that it swept out the two-ton safe from the produce market of Office Bros. in the Fourth and St. Clair corner of the building and carried it beyond the corner of Fifth and Jefferson Streets, a distance of more than two blocks, approximately 800 ft. Among the debris continually brought down against the structure was a large oil tank 20' in diameter and 12' high, filled with oil, which struck the northeast corner pier of the building. The collison resulted in little damage to the structure, but the oil tank fortunately was punctured, which allowed the oil to escape and removed a threatening possibility of fire and explosion.

When the flood waters were highest, an explosion occurred in a pharmacy a half block distant from the Beaver building and the store immediately took fire. The flames spread to the adjoining buildings and then leaped Third St. into the block of which the Beaver building is a part. In this block, among other things, were located paint and supply stores of Lowe Bros., Barrett Mfg. Co., and Irwin, Jewell & Vinson. Lowe Bros. likewise had a paint warehouse. There were also several liquor houses and a hardware and ammunition store of Clem L. Kimmel, which was in close proximity to the concrete building. These stores furnished fine fuel for the fire. Flames shot up 150' in height.

Building Sheltered a Host

As soon as the conflagration became threatening, people in the surrounding frame and brick structures immediately fled over roofs, over spaces spanned by hastily built make-shift bridges and sought safety in the fireproof concrete building. Two janitors and three clerks aided in the rescue work until there were 300 people housed in this structure. The wind brought down the fierce conflagration on the Beaver building, and the unmolested flames entirely destroyed the houses across the alley and 14' distant down to the water-line. So intense was the heat, even inside the concrete building, that the refugees could not, under any consideration, approach nearer than 20' to the wall adjacent to the flames. Fortunately the temporary occupants had had sufficient foresight to make their position more secure by previously removing all inflammable stock from that side of the structure threatened by the flames. The only damage which the concrete building suffered was a slight spalling of the exposed concrete surface and a few broken window panes, which were shattered by bullets from the exploding ammunition in the hardware store. The sash steel[1], but the panes were not of wire-glass and were consequently so badly damaged that all on the side attacked by fire will have to be replaced.

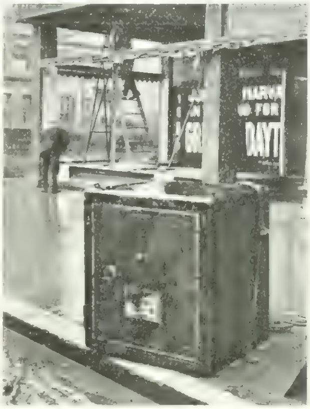


Fig. 2—The Beaver Bldg., Dayton, O., Which Stood a Flood That Was Strong Enough to Sweep This Safe 800 Ft.

The refugees were marooned from Tuesday morning until Friday. A motor boat brought some supplies Thursday morning, but previous to that time they were forced to subsist entirely on candy as food and grape-juice as drink, which they obtained from a candy factory located in the third floor of this building. The furnaces were in the basement and were consequently useless. To make the women and children more comfortable, charcoal fires were built in forges brought up from machine shops on the second floor.

Beaver building No. 1 was designed and built in 1909 by Schenck & Williams, architects, and O. P. Hazen & Co., contractors, Dayton, O. It was planned as a three-story structure, but at the time of its erection a fourth and a fifth story were added. Its dimensions are 170' by 204' with the first story 14' and the others 12' in height. The cost was approximately $140,000. It is of the beam and girder type. As this was one of the early reinforced concrete buildings erected in Dayton the public had for some time a false idea that the "cheese" building, as they called it, was

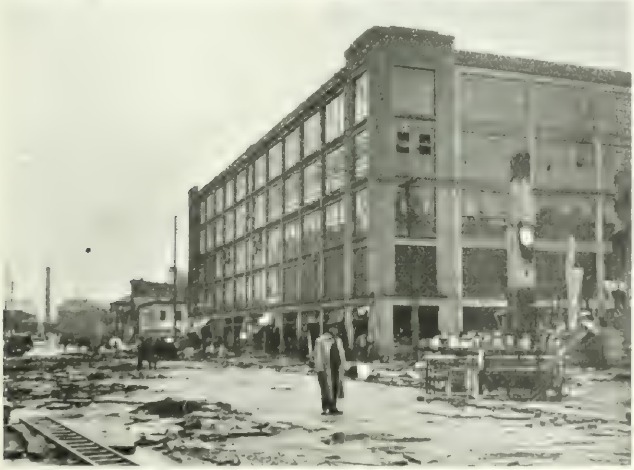


Fig. 1—The Beaver Bldg., Dayton, O., Which Resisted Fire and Flood

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[1] [illegible]

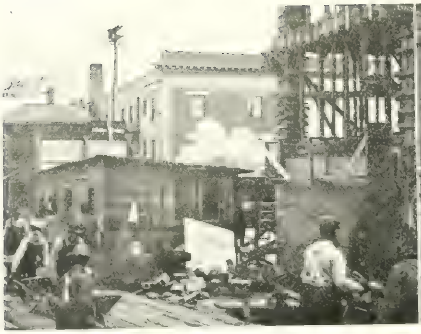


Fig 1—Work on the Studebaker Building, Minneapolis

At the door of the shed two men are emptying sacks of cement into wheelbarrows

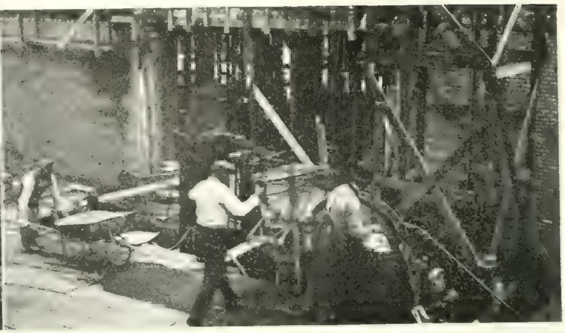


Fig. 2—Bulking Bagged Cement

The wheelbarrow load of sand goes into the mixer; the load of cement is waiting

not safe, and consequently the owner, Fred L. Beaver, was unable to rent anything except the first floor. Ultimately he himself lost faith in his structure and gave a long-term lease on it to the architects. Eventually all space was rented and so satisfactory was this first concrete building that it has made this type of structure a favorite in Dayton.

Two days after the flood waters subsided the Beaver building was ready for operation. In this respect it ranked first of all structures in Dayton. It was materially aided by the fact that, on account of the rigidity of its structural material, the elevator motors were located overhead and entirely above inundation.

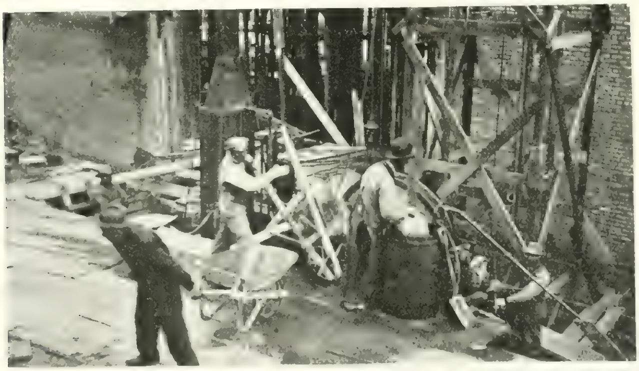


Fig. 3—This Shows the Wheelbarrow Load of Cement Going Into the Mixer

Even before the flood the Beaver building was one of the most popular structures in the city and space in it was always at a premium. Needless to say, its popularity has not been decreased by recent events.

John McLaren Pettyjohn, of the Pettyjohn Co., Terre Haute, Ind., has been granted a design patent on an ornamental concrete illuminating standard. This standard has been in use for some time. The company is now installing 65 standards at DeKalb, Ill.

Bulking Bagged Cement Obviates Congestion at Mixer

Much interest is now being directed toward the possible economy factors offered by handling cement in bulk instead of putting it into sack containers at the mill. As throwing an interesting sidelight on the problem as a whole, the accompanying photographs and letter received from B. H. Stahl, of Haglin-Stahr Co., contractors, Minneapolis, is of value.

These contractors empty the cement into wheelbarrows at the cement shed and wheel it to the mixer. By doing this, they state, the congested conditions around the mixer are largely eliminated; sacks are emptied in the open and kept together in a dry place, away from the water which is usually found around the mixer. The actual time, too, required for dumping the cement into the mixer is far less from wheelbarrows than from bags. If these contractors believe that it is better to handle cement in this way even when it has been received in sacks, it would certainly seem that there must be considerable value to the suggestion of shipping cement in bulk.

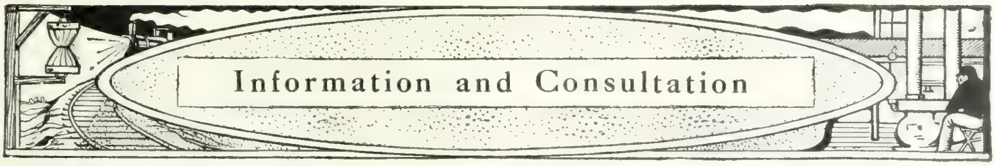
It should be pointed out, however, that on most work a man is required behind the mixer to superintend the general operation of getting the sand and aggregate into the mixer and part of his work usually consists of emptying the cement sacks into the mixer hopper. It is not clear therefore what labor is actually saved under this arrangement. The saving in time is apparent. The letter follows:

"In regard to our methods of dumping cement into wheelbarrows at the Murphy garage we wish to say that this was done mainly to relieve the congestion caused by large piles of cement sacks around the mixer. We also keep the cement sacks dryer and save loss on them.

"Our experience has been that it does not cost any more to dump the cement into wheelbarrows in the cement shed and then dump into the mixer than to handle in the usual way. Our men have been doing this for several years and we had not thought there was anything novel about it, until we received your inquiry."

Forms for Siphon Spillways

In the July, 1913, issue appeared a description of siphon spillways, which are used in concrete dams to take care of the overflow, and of interest in this connection is the way in which the forms for these siphons are built. The openings for the siphons are so small that the recesses formed in the masonry are somewhat difficult of access. On the work at Smith Basin, Contract No. 25, N. Y. Barge Canal, the forms for the siphons were divided into four sections. The forms for the inlet and the lower part of the outlet were made in the ordinary manner, as it was possible for a man to work in these portions and tear out the forms after the concrete had set. The form for the downstream leg from the outlet to the crown was made collapsible and the concrete was deposited up to the level of the crown and allowed to set; afterwards the form was collapsed and removed. The form for the crown of the siphon was inaccessible and could not be removed. It was, therefore, made of cast iron and left permanently in place.



Information and Consultation

We learn best by doing. This department is a place of exchange between those men who know from specialized experience and those men who want to know. The Discussions are specific and direct. In the following pages the topical heads show the many lines of activity in the concrete field which are covered. Questions and Discussions are cordially invited

286. Concrete Floors in Soap Factories

"Do the fats and alkalies used in manufacturing soap have any effect on concrete wearing surfaces?"

286. Discussion by C. W. Boynton*

In regard to the use of concrete floors in soap factories, we wish to say that so far a thorough search of our reference files and library has disclosed only one account of such work. This deals with the concrete floors for the soap factory of Armour & Co., Chicago, built in 1905-06, the construction of which is described in *Engineering Record* for June 2, 1906. The superintendent of this plant has told us that these floors, which have now been in use over 6 yrs., are not protected from the lye or fatty acids that reach them and he does not see that they are damaged to any extent by the use they receive. He believes that mineral acids would, no doubt, injure the floors if the process were one in which mineral acids were used. Of course, concrete floors intended for such purposes should be given at least two weeks' time to harden thoroughly before they are put into service, as the green concrete might be damaged by the lye and acids spattered upon it, as happens more or less in the operation of soap making.

286. Discussion by W. H. Kellogg, Jr.†

Mr. Pacini in an article entitled "The Hydration and the Hydrolysis of Portland Cement" which appeared in your paper of Dec., 1912, and April, 1913, has outlined a generalization to cover chemical disintegration of concrete caused by electrolytes in solution. The deteriorating action of caustic soda would fall into this class of reactions and may, therefore, be considered an accelerated hydrolysis of the cement. In addition, caustic soda has a direct solvent action upon silicates and aluminates, forming sodium silicate and sodium aluminate, both salts being quite soluble in water. This, of course, means a direct removal of the acidic elements of the cement colloid and its decomposition.

As to remedies, the obvious one is to keep the caustic soda away from the concrete and the majority of waterproofing materials are perfectly useless in this case, since they are attacked by the alkali. Any saponifiable material, such as oily or fatty or resinous bases, is removed by the soda. A continuous stratum of iron oxide deposited in the pores of concrete should be absolutely permanent and will develop, we believe, into a perfect protection.

In one of the electrolytic processes for the manufacture of the caustic soda, the diaphragm between the electrodes is packed with iron oxide, as the most resisting material available under these trying conditions.

* * *

288. Wrapping I-Beams

"What is the best way of wrapping I-beam with wire or wire mesh to prevent the concrete below the bottom flange from cracking and dropping off?"

288. Discussion by C. O. Powell*

We agree with the point brought up in Prof. Woolson's discussion of this question on page 180 of the April, 1913, issue, in regard to using a very light weight metal lath for fireproofing steel beams. We always recommend the use of 1½-in. mesh, 18-ga., or 2¼-in., 16-ga., expanded metal for this class of work. This provides a mesh with a large opening that will allow the concrete to flow through the meshes and eliminates the difficulty mentioned by Prof. Woolson in the use of a light weight metal lath which is forced up against the I-beams by the weight of the concrete. The heavier strands of this material are not so quickly affected by corrosion as is the light weight lath.

* * *

303. Concrete Septic Tanks for Sewage Disposal

Will a tank such as described in the Sept., 1912, issue, require a filter, or, as I believe it is technically called, a "contact-bed?" As I understand it, a septic tank is a dark chamber, hermetically sealed from the air by its own contents, in which certain bacteria, technically called "anaerobic bacteria," are generated, liquefying and destroying the solids in the sewage. Now according to the article in the Sept. number, I would suppose the first or charge tank is the one in which the anaerobic bacteria are generated. Is the second the one in which the aerobic bacteria are generated? If so, does the water come out sufficiently pure, clear and free from contamination to be discharged into a pond?

Applying the design as illustrated in the Sept. number, may I have more information on the following points: I am planning to build a tank for 400 persons, to be 40′ x 20′, 4′ deep, with two tanks.

1st. Would such a plant require any attention other than cleaning once every two or three years?

2nd. Would this suggested design be all right with a 4-in. concrete roof, reinforced with 90-lb. steel rails, 21′ long placed every 10′ transversely, and the slab reinforced with ½-in. rods either way, 8″ o. c. All concrete 1:2:2½.

3rd. Could a man guarantee such a plant to discharge clear water free from offensive odor (without filtering)?

4th. Would the second tank need to have a lot of air holes in the second compartments?

5th. This plant at present will be used for only 180-225 people. I have heard that a tank larger than is immediately needed will not work well. Can you furnish any information?

6th. Is this tank built according to the Cameron patent for septic tanks?

303. Discussion by Theodore Aten*

The dimensions (40′x20′x4′) of tank would be of sufficient capacity to take care of the sewage of 180 to 225 people but would be utterly inadequate for 400 people. The relative proportions of tank, however, are incorrect and I would suggest a 40-ft. x 12-ft. x 6-ft. tank as preferable for securing a better bacterial action.

1. It should be unnecessary to clean out a tank of these dimensions less than every two or three years, providing it is used for the lesser number of people. If overloaded by the greater number (as stated above) it would necessitate being cleaned out in a much shorter

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*Engr. in Charge, Information Bureau, Universal Portland Cement Co., Chicago.

†Sec., Girvan-Nachod Co., N. Y. C.

*Engr. North Western Expanded Metal Co., Chicago

*N. Y. C.

period, say, every 6 months or possibly once a year.

Not having seen the plans, it would be impossible for me to state definitely what bacterial action you would secure in your proposed tank.

2. The roof, as described, would be of sufficient strength to carry required loading.

3. The sewage effluent from this tank could not be expected to be clear or free from contamination or offensive odors, until it had passed through a filtering process, which is secured by means of filtering beds.

4. I do not advocate air holes in the second compartment, as it is desirable to promote only anaerobic bacterial action in these tanks. The aerobic action takes place in the filtering beds.

5. A tank of sufficient capacity to take care of the sewage of 400 people would have quite as satisfactory results if used for a lesser number.

6. As advised in question 1, not having seen the plan of this tank, it is impossible for me to state whether it accords with the Cameron septic tank or not.

* * *

311. Fastening Machinery to Concrete Ceilings

"Our problem is to take care of the shafting and various machinery in a small machine shop. Instead of trying to work out beforehand the positions of all the overhead machinery, motors, jack shafting, etc., we thought it might be possible when we run the floor to put in some of these lower cost insert anchors, say 4' on centers each way, or even 2' on centers each way. By bolting 2 x 4's or 4 x 4's to these at any point we could place the machinery anywhere we want to or change it at will. Is this done at all and what further advice can you give us?

311. Discussion by Julian Richmond*

The cheapest and most efficient way of fastening machinery to ceilings and walls is a problem ever arising in architects' and engineers' offices. Solutions are numerous and varied.

The simplest ways, of course, are to anchor, at the approximate desired location, a stick of timber, or to embed a cast iron or sheet metal insert. The wood sleeper requires an anchorage of its own and furnishes in turn anchorage to the machinery in a sort of middleman fashion. Large cast iron or malleable iron inserts have been designed for the purpose, recessed to permit the sliding in one direction of bolts set head in, the threaded portion with a nut engaging the machinery or fixture.

The sheet-metal inserts are similarly designed and used but have the possible disadvantage of greater tendency to rust. There is one fundamental disadvantage to the general solution by use of inserts. It is that they always interrupt the continuity of a concrete or reinforced concrete structure. With the best of lugs, they still resemble too much a knot in a stick of timber.

Wall plugs of small dimensions do not seem adapted to hold heavy vibrating work. There remain, therefore, the various expansion shields and screw anchors. The true expansion shield embedded in concrete loses its expansive function and degenerates into a split insert.

Many of the screw anchors have the disadvantage of the larger metal inserts without the corresponding advantage of freedom of location for the bolt. We have heard of cases in which large slabs of concrete flaked from the ceiling through the weakening action of large inserts.

The theoretically perfect solution would be so to mold or arrange the reinforcement as to permit its engaging the screws or bolts directly.

Where the exact location of every possibly required bolt is known beforehand, it is practicable to use:

(1) Slotted cast, malleable or sheet-metal sockets taking one or more machine bolts under the head.

(2) Individual cast or malleable iron inserts for taking the threaded end of a machine bolt, and

(3) Wire anchors engaging the bolt threads directly.

The advantages and disadvantages of the three above methods are stated in the following paragraphs:

(1) Advantages—one socket may hold a number of bolts; bolts are adjustable in socket (in one direction); size and weight of socket reduce liability of displacement during pouring of concrete.

(1) Disadvantages—cost high on account of size; introduces source of weakness to floor by interrupting continuity of concrete and of reinforcement. Face of socket exposed to view and interior to condensation, causing rust.

(2) Advantages—ease of setting; low cost.

(2) Disadvantages—although easy to set, when stuck on small plugs, etc., a slight warping of form surface or even the weight of wet concrete will throw them out of plumb, as will the introduction of grout; exposed metal surface objectionable as rust-producer; strength limited by depth of insert; not made in large sizes; impossibility of galvanizing or rust-proofing threaded portion.

(3) Advantages — cheapness, great strength, obtainable at no increased cost by deeply embedding the anchor; neat appearance of hole which shows no metal at surface; possibility of rust-proofing; no weakening of concrete; no interference with reinforcement or embedded lighting or other pipes.

(3) Disadvantages—necessity of boring forms to hold bolt and anchor during concreting; necessity of removing bolts before stripping forms.

Where it is not feasible to lay out each attachment in advance, the solution of ceiling attachments by using wooden plates, say 4x4's, themselves fastened to permanent anchors embedded in the concrete and in turn holding counter-shafts, machinery, etc., is entirely a feasible and economical proposition. To fasten the wooden sleepers, all of the commonly advertised inserts and screw anchors will serve.

The main precaution to take is that the insert or anchor shall be embedded to a sufficient depth. Cases are known of large slabs of small thickness coming down with the insert like plaster from a ceiling when the insert was large and shallow and there was a layer of weak concrete above it. Another point to note is the advantage of using numerous inserts, say upon 2-ft. spacing each way. This permits shorter spans for the sleepers, a stronger construction and great flexibility of lay-out through the possibility of attaching the sleepers along numerous angular lines.

A proper design would require equal strength for the fastening in the sleeper and for anchorage of the sleeper in the concrete.

* * *

316. Cost of Concrete Sidewalk

"What will it cost to lay a walk 108 long, 26" wide, with a 5-in. cinder fill, 5" of concrete and a 2-in. top dressing or wearing surface? Mix 1:2:4 concrete, top dressing 1:3.

"Cement costs $1.95 per bbl., cinders about 50c per load of 1 cu. yd., sand $1.75 per ton, stone $1.75 per ton. Labor —finishers 35c, helpers 22½c per hour.

"What quantity of each of the materials—sand, stone, cinders and cement —will be required? How many sq. yds. is one man supposed to lay under ordinary conditions in one day of 8 hrs?

"In the above questions it is assumed that the excavation is to be completed and not to be figured in the cost. Could I have as much detail as possible explaining how the amount of each ingredient is arrived at?"

316. Discussion by C. W. Boynton*

The cost of a concrete sidewalk is generally figured per 100 sq. ft. and we have figured the cost of this walk under the conditions as stated and with the price of materials as given, on that basis:

Sub Base:

With cinders at 50 cts. per cu. yd. delivered, 5-in. sub-base would cost:

$$\frac{100 \times 5 \times \$.50}{12 \times 27} = \$.77 \text{ per 100 sq. ft.}$$

Base

The concrete base 5" in thickness and 100 sq. ft. in area would contain:

$$\frac{5 \times 100}{12 \times 27} = 1.54 \text{ cu. yds.}$$

One cu. yd. of 1:2:4 concrete requires 1.51 bbls. of cement, .45 cu. yds. of sand and .89 cu. yds. of crushed stone.

The amount of these materials required for 100 sq. ft. of concrete base would, therefore, be 1.54x1.51=2.325 bbls. of cement; 1.54x.45=.693 cu. yds. of sand and 1.54x.89=1.37 cu. yds. of crushed stone.

Top Coat

The top coat 2" thick and 100 sq. ft. in area would contain .6173 cu. yds. As one cu. yd. of 1:3 mortar requires 2.39

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*Richmond Screw Anchor Co., N. Y. C.

*Engineer in Charge Information Bureau, Universal Portland Cement Co., Chicago bbls. of cement and 1.06 cu. yds. of sand, the amount of these materials required for the mortar top would be:

.6173x2.39=1.475 bbls. of cement.
.6173x1.06= .654 cu. yds. of sand.

Materials:

Adding the amount of cement, sand and crushed stone required for the base and top coat together and multiplying by the cost of these materials as given, considering that a ton of sand is 20/27 of a cu. yd., we have the cost of these materials as follows:

(2.325+1.475) $1.95=$7.41 per 100 sq. ft. cost of cement.

27/20 (.693+.654) $1.75=$3.18 per 100 sq. ft. cost of sand.

27/20x1.37x$1.75=$3.24 per 100 sq. ft. cost of stone.

Adding these costs together and including therewith the cost of cinders as figured above ($.77) we have a total cost for materials per 100 sq. ft. of sidewalk of $14 60

Labor:

We estimate that the cost of laying such a sidewalk as you describe will be about $2.15, making the total cost of this pavement $16.75 per 100 sq. ft.

Because of various methods employed and because of the great variation, due to width of walk, we have neglected the cost of the forms themselves, although the labor for erecting these has been included.

We have also assumed that the prices given were for materials delivered on the job and that the cost of excavation was not to be added to the estimated cost of the sidewalk.

Standard Sidewalk:

Such a walk as described is by no means a standard walk. The cinder fill under the concrete sidewalk is seldom made less than 6" in thickness. The concrete base should be 5" in thickness, but is rarely made of 1:2:4 concrete; 1:2½:5 is the mixture generally employed for this purpose. The top coat is rarely proportioned leaner than 1:2 and we recommend that 1:1½ be used for this purpose. The thickness for the top, however, need not be greater than 1" and we recommend this thickness for such work.

With a walk such as described above, using the cost of materials as given and following the same method of figuring as indicated in the first case, we find that the cost of materials for 100 sq. ft. of walk will be $12.70. This figure is arrived at by remembering that a cu. yd. of 1:2½:5 concrete will require 1.24 bbls. of cement, .46 cu. yds. of sand and .92 cu. yds. of crushed stone and that a 1:1½ mortar requires 3.87 bbls. of cement and .86 cu. yds. of sand per cu. yd. of mortar. The labor cost for laying this sidewalk will be less than in the first case and we have considered that $2.00 will be the proper figure for this item.

Adding the cost of materials and the cost of labor we obtained the total cost per 100 [illegible] ft. of [illegible]walk [illegible]

$12.70 plus $2.00=$14.70 per 100 sq. ft.

[illegible]

[illegible]

and 26" wide, contains 108x2.16=244 sq. ft. In the first case, that is using the walk as described, this top will cost 2.44x$16.75=$40.89. Following the second method as described above, the walk will cost 2.44x$14.70=$35.86.

A finisher and helper should finish between 600 sq. ft. and 800 sq. ft. of walk per day of 10 hours and in the figures given above we have assumed 700 sq. ft. as a day's work.

318. Concrete in Alkali Soils

"What has been the experience of users of concrete pipe and tile in alkali soils? How are concrete tile to be made to resist the disintegrating effects of alkaline solutions?"

318. Discussion by A. C. Tunison*

When pipe are made of cement, sand and gravel they are called concrete, no matter what the quality of cement, sand or gravel, or process of manufacture may be. Alkaline solutions, as we all know, are cleansing in their effect and my experience and observation have confirmed my belief that concrete made of a lean mix, dirty aggregates and not enough moisture in the cement to cause perfect hydration will be acted upon by alkali in the following manner: The alkali will dissolve the dirt with which the sand and gravel are coated, and so separate them from the cement; thus we would have a disintegrating action from this cause. However, distilled water will act in much the same manner. My contention is that this class of concrete work is not concrete.

Where the mixture is of the right proportion and clean aggregates used, enough water to cause perfect hydration of the cement and the concrete kept wet for 8 das. to 10 das., concrete will be made that will not permit of the action I have mentioned, and tests which have been made show that concrete thus made does not lose strength after immersion for several weeks in strong alkaline solutions.

In support of my statement, I call your attention to your discussion No. 286: "Do fats and alkalies used in manufacturing soap have any effect on concrete wearing surfaces?"[1] By carefully reading this article the relation to my own contention is evident.

In almost all alkali soils it would be impossible to find a condition that would be as severe as the one mentioned here. Further I call your attention to a letter to A. S. Bent, Los Angeles, from M. E. Sullivan, as follows:

Longmont, Colo., Nov. 1, 1910.

Your letter of Oct. 27, 1910, just received, in which you ask for information in regard to the action of alkali water and alkali soil on cement pipe and concrete structures.

In reply I will state that I have been building cement concrete structures in Colorado for the past 20 years and in most cases the concrete was originally mixed with strong alkali water and most of the structures were built in very thoroughly saturated alkali earth and water. In all my experience and observation I have never yet seen or known of any failure of concrete that could be traced to the effect of alkali.

The cement pipe made at Rocky Ford, Colo., several years ago which went to pieces under ground in 8 months after it was made, and the pieces of which were sent to Prof. W. P. Headdin, of the Colorado Agricultural College at Fort Collins, Colo., for chemical analysis formed the basis for the general scare on the alkali question. I took great pains to investigate this case very carefully and the cause of the failure of that cement pipe.

It is not to be supposed that a college professor with no practical knowledge or experience with making, condensing and properly curing cement products, would or could know the real cause of any given failure of concrete. My own investigation of that now celebrated and widely advertised failure elicited the following facts: The pipe was made by Joe Latson, Rocky Ford, Colo. It was the first cement pipe he had ever made. He had no experience whatever in making or curing concrete. The pipe was made on a revolving table machine which does not tamp or compact the material, but leaves it very porous.

The pipe was made of exceedingly fine, dirty sand, full of silt and mica. It was mixed 1 cement to 5 of the above fine, dirty sand. It was a dry mixture, just enough water to kill the cement and not enough to set it. It was not wet down after being made dry until the cement was dead. Of course, after the cement had thus been killed, no amount of sprinkling could bring it to life again. Distilled water or melted snow water will dissolve any cement work thus made. Alkali absolutely had nothing to do with this failure.

I obtained these facts from Mr. Latson and from Prof. Headdin and I have all the correspondence in the matter now at my hand. On the other hand I can show any one who cares to investigate, hundreds of concrete pipes, outlets through dams of reservoirs of water strong enough in alkali to take the hair off the legs of horses and cattle that wade into it, that have been in place saturated with alkali continuously for 20 years and in perfect condition today. In the northwest part of this town (Longmont, Colo.) was formerly a natural basin which received the seepage water from a large body of alkali land.

In 1882—28 years ago—an 8-in. cement pipe drain was made and laid to carry away this red alkali water. This pipe is still in good condition as ever. In April, 1891, I wanted to lower the machinery in my electric light and power plant in Longmont, Colo., from the first floor down into the basement. The building stands at the foot of a hill on a flat in St. Vrain bottom and the basement is excavated to a depth of 10 ft. or 12 ft. below ground surface. There was no chance to drain this basement of the stinking alkali seepage water that stood 2 ft. deep and smelled like sulphureted hydrogen gas and rotten eggs.

This water was reddish brown and full of black alkali. I dumped boulders and gravel into this water in the basement and tamped them down with heavy mauls, until there was about 1 in. depth of this water still showing above the tamped gravel. I then mixed concrete dry and added no water to it at all. This dry mixed concrete was spread carefully in the alkali water, and was then tamped with heavy tampers until the alkali water was drawn up through it to the surface. That floor is as sound and as hard today as any concrete work in the United States. It was put in in April, 1891, over 19 years ago and has been soaked in the very strongest alkali ever since. I have built inverted siphons from 8" diameter to 9' diameter in strong alkali soil and water and mixed the concrete with alkali water for many years past, and I have never yet had a failure from any cause.

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*[illegible] Pipe Machinery Co., Salt Lake City

[1] Editorial discussion p. 287 June, 1913, issue

Coarse, clean, hard sand and plenty of cement and water thoroughly mixed, well compacted, and kept wet and protected from cold, wind and sun for 10 das., will never be affected by alkali.

Yours truly,
(Signed) M. E. SULLIVAN, C. E.

318. DISCUSSION BY C. W. BOYNTON*

For some time past there have been discussions as to the action of alkali on cement drain tile, and a number of solutions of the problem have been advanced.

Recent developments, however, tend to confirm the statement which has been made more than once in previous years that the question is really one of materials and workmanship and that success in making cement tile to meet alkaline conditions depends upon the selection of suitable aggregates for the mixture, the use of proper proportions, and upon methods of manufacturing and curing the tile that will insure satisfactory density and strength.

While many of the alkalis found in the soils of our western states have no bad effect upon dense concrete, there are some that do noticeably affect concrete that is weak and porous. However, it should be stated here that the alkali which will thus act upon concrete will also affect many other materials.

The following paragraph is quoted from the summary of the report made by the Bur. of Standards, entitled "The Action of the Salts in Alkali Water and Sea Water on Cements" and known as Technologic Paper No. 12.

"Portland cement mortar or concrete, if porous, can be disintegrated by the mechanical forces exerted by the crystallization of almost any salt in its pores, if a sufficient amount of it is permitted to accumulate and a rapid formation of crystals is brought about by drying; and as larger crystals are formed by slow crystallization, there would be obtained the same results on a larger scale, but in greater time, if slow drying were had. Porous stone, brick and other structural materials are disintegrated in the same manner. Therefore, in alkali regions where a concentration of salts is possible, a dense, non-porous surface is essential."

Cases of porous concrete are generally traceable to the use of lean mixtures, unsuitable aggregates or to poor workmanship. The letter from A. R. Beymer, Rocky Ford, Colo., which has already appeared in *Cement Age* for Feb., 1911, is a good illustration of this point. Mr. Beymer has had considerable experience with concrete tile exposed to alkaline soils and is firm in the belief that concrete when made right will stand.

On a recent trip through the West made by a member of this company, a concrete trench built on the top of the ground was found on the farm of Mr. Cravens, at Grand Junction, Colo. This trench has been in use for a number of years. Water is conducted from it through holes in the sides practically level with the bottom. When the holes are open, water flows directly from the trench into furrows. Although we can assume that the water in the trench is low in alkali, the soil on the outside carried a great deal of alkali and there is a splendid opportunity for the mixture which the soil takes up to dissolve out the alkali, be absorbed where it comes in contact with the concrete, if the concrete is at all porous, and upon evaporation be distributed in the walls of the trench. At many of the outlines along this trench a careful examination was made to see if there were signs of disintegration, but no weakness whatever was found in the concrete.

Mr. Cravens is enthusiastic over the use of concrete and states that he has never seen a piece of concrete affected by alkali if the concrete was made with any intelligence whatsoever, and contained anything like a proper amount of cement.

The whole question is very similar to that of waterproofing, and it has been many times successfully demonstrated that with proper care, concrete can be made watertight without the addition of any waterproofing compound. If the proper proportions are taken to secure a watertight concrete, we believe that this concrete will give satisfactory results in alkaline soils.

318. EDITORIAL DISCUSSION

A. S. Hurlbut, of the California Glazed Cement Pipe Co., Los Angeles, forwards letters which we publish as follows:

March 20, 1913.

Mr. Arthur S. Bent,[1]
Los Angeles, Cal.

Dear Sir:

The city of Longmont has between 11 mi. and 12 mi. of your concrete pipe on our main supply pipe line from the mountains. About three miles of this line is laid through alkali flats that destroyed a steel pipe in a few years. The pipe was leaking in five years and is now worthless after a service of 10 years. We will strengthen this line in several places by a reinforced concrete covering this spring, using the old pipe simply as a form. The concrete pipe laid in 1910 shows no deterioration whatever and has given such good service that we expect to replace the old steel pipe in the manner stated above in sections where the pressure will run from 30 lbs. to 40 lbs.

I have a piece of concrete that was in the ground for 17 years in the worst alkali ground that there is in this vicinity, part of a joint on a vitrified tile that is in first class condition. This line crossed the eastern portion of the McIntosh Reservoir, about two mi. from Hygiene. I can send you a sample if you want it.

I am only too glad to be able to recommend your work at any time, as it has proven its worth in our plant. We have been operating the power plant for over a year and have used the upper line above the power plant constantly for two years and the lower line continuously since it was turned over to the city at the time of the acceptance of the work.

R. E. RICHARDSON

Civil Engineer
Longmont, Colo.

Winnipeg, March 22, 1912.

H. F. Osler
The Perfection Concrete Co.,
Winnipeg.

Dear Sir:

I reply to your request that I should give my expert opinion as to whether or not the alkaline salts present in the subsoil and clay of this city of Winnipeg would act upon thoroughly sound concrete, previously set and hardened, so as to cause disintegration and premature failure of concrete pipes.

I have to state that out of an experience extending over seven years, during which I have been engaged as chemical engineer to the Canadian Pacific Ry. Co., and throughout which time I have conducted the testing of cement for important work, extending from Fort William to Vancouver, including from time to time special investigations into the effect of excessively saline and alkaline waters upon concrete, I can state that I have not yet come across a case where good concrete made from first-class Portland cement, completely buried, has been affected bv the composition of the soil or clay or ground water by which it was surrounded.

The results of my investigations have shown that even where the concrete was mixed and made with water containing excessively high contents of salts of soda and magnesia, the concrete did not show any appreciable loss in strength as compared with the same concrete made with pure water.

It is, I may state, well known that sound concrete composed of normal cement completely submerged in sea water, which is far more saline than any shallow ground waters existing in Winnipeg, remains perfectly sound and good as though it were natural rock.

The action of alkaline salts on porous concrete has frequently been observed and investigated as well as upon concrete exposed to sea water and the action at the tidal zone is the result of the alternating changes produced by the intermittent submersion and aeration, but such action at tidal zones is generally destructive in nature and does not apply to completely buried concrete.

If, however, concrete is rough on the exterior, such as mass concrete formed with rough ground as a mold, or rough-surface, porous and imperfectly made pipe is employed and buried in alkaline or saline earth, disintegration is likely to ensue, because the interstices permit action to begin and proceed. These are, however, cases of faulty construction and imperfect materials and would apply to a water main constructed of inferior cast iron pipe, whereas a main laid of perfect cast iron pipe would effectually resist action and serve the usual period of usefulness.

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*[illegible]

[1] Manager California Glazed Cement Pipe Co., Los Angeles.

(Signed) HENRY B. LAKE
Chemical Engineer
Canadian Pacific Railway Co.
Winnipeg.

Of the utmost interest and importance in this discussion is Paper No. 12: Action of the Salts In Alkali Water and Sea Water on Cements, of the United States Bur. of Standards. From this paper we quote only the Introduction and the Summary. Interested readers should obtain the full report from the Bur. of Standards, Washington, D. C. We quote:

Introduction

The disintegration of cement structures, when placed in contact with sea water, is a phenomenon which has attracted the attention of cement manufacturers and cement users almost from the first time that such material was used for marine construction. There are cement structures which have withstood the action of sea water for years and probably will continue to do so, yet there are structures which have failed; and it is also possible in the laboratory by artificial solutions to destroy almost completely a briquette, or cube, or cylinder made of cement mortars or concrete. The cause of this disintegration is not certain, though it is almost universally believed that it is the reaction of sulphate of magnesia of the sea water with the lime of the cement (formed during the setting) and the alumina of the aluminates of the cement, resulting in the formation of hydrated magnesia and calcium sulpho-aluminate, which crystallizes with a large number of molecules of water.[1]

The other constituents both of the sea water and the cement are usually considered of little effect, though lately attention is being drawn to the fact that both sodium chloride and magnesium chloride rapidly attack the silicates.[2]

Concrete structures have been made (especially in this country) which are resisting the attack of sea water to a marked degree. It is therefore not surprising that many engineers attribute the disintegration when it does occur to poor workmanship or materials, or to the abrasion of the sand or floating bodies in the water, and to the mechanical action of waves and frost action (as the disintegration usually takes place at or near the water line) rather than to any chemical reaction or crystallization due to such reaction.

It is not surprising that when cement structures were first placed in our arid regions this disintegration was not considered, though it was well known that these regions contain large quantities of magnesium sulphate, which, together with the sodium sulphate, forms the principal salts of the so-called "white alkali" in distinction from the black alkali, which is largely sodium carbonate. However, a short time after these structures were placed it was noticed that there was a softening of the mass along the water line and in due time this attracted considerable attention. It was investigated first by the Colorado State Agricultural College[3] in the case of some disintegrated cement tile; and the Montana State Agricultural College in the case of the sewers and culverts of the city of Great Falls.[4]

These investigators, however, do not discuss the cause of the destruction other than to mention the sulpho-aluminate of lime formation, and in the case of the cement tile to mention that the silica and alumina were removed.

As the U. S. government has been locating a large number of its irrigation projects in such regions, it was considered to be within the scope of the investigation of the Structural Materials Laboratories to make a study of this condition. Richard L. Humphrey, engineer in charge of the laboratories at this time, visited the Bellefourche project in South Dakota, the Shoshone project in Wyoming, the Sun River project in Montana, and the cities of Great Falls and Billings, Mont. In all of these he noticed alkali disintegration of the concrete, stones, and brick, and collected samples of the water, the alkali efflorescence and the soils, also a few samples of disintegrated concrete. The alkali proved to be the characteristic white sulphate alkali.

As a rule it was noticed at the projects visited that with increasing amounts of magnesium sulphate disintegration was greater, although this was not always the case. As it had been previously found in sea water, this action occurs at the water line, extending from the low-water line to a few inches above the high-water line, caused no doubt by the concentration of salts at this point from the evaporation of the water. In the case of structures placed in damp earth—as the wings of "drops" or "gates"—it was found that the action extends from a few inches below the surface of the earth to several inches above it. Below the surface of the earth the concrete was soft and a trowel or knife could readily be pushed into it. There was also some swelling. Above the surface the mass was much drier and harder, but was swollen and readily pulled off in layers. Not only was the concrete noticeably disintegrated, but bricks, sandstone, and even granite (though to a small extent) were also disintegrated. A piece of spalled sandstone from the courthouse at Great Falls and another from the First National Bank Bldg. at Billings showed the following sulphate and chloride present:

	Na_2SO_4	K_2SO_4	$CaSO_4$	$MgSO_4$	NaCl
Great Falls..	16.16	1.60	2.62	23.60	0.47
Billings	31.2	[illegible]	[illegible]	[illegible]	[illegible]

This phase of the disintegrative power of alkali on these building materials, usually used in place of concrete, has not been generally noted; and when it occurs in such materials, relatively so inert chemically, it would seem to point to the fact that the crystallization of the salts already present in the alkali can cause great destruction, without assuming that there is any chemical reaction with the cement.

Later the Truckee-Carson project in Nevada, the Umatilla project in Oregon, the Klamath project, Oregon, and the Sunnyside and Tieton projects in Washington were visited. But very little disintegration was noticed. There was plenty of alkali in the first project mentioned, but with the exception of the case of a small "drop" no action was visible. The same applies to the other projects, where no disintegration whatsoever was noticeable.

Scope of Investigations

These investigations were planned for the purpose of determining the suitability and permanency of various cements in structures exposed to the chemical and mechanical action of sea water and alkali salts and, if possible, the cause of failure or disintegration of cements and concretes.

The study of the subject was begun in such a manner as to determine, if possible, just what reaction would take place when the salts, commonly present in sea water and alkaline soils, were allowed to act on cement and cement mortars. In order that the study should be complete, information should be obtained not only as to what salts present in any solution might cause destruction, but also in what manner this destruction is being accomplished. Both chemical and physical investigations were made in the laboratory, and field tests in sea water were made at Atlantic City, N. J. In both series of laboratory tests reported in Part I of this paper there have been used at various times, in addition to sea water from Atlantic City, solutions of sodium chloride, sodium sulphate, sodium carbonate, magnesium chloride, magnesium sulphate, ferrous sulphate, and also solutions in which there were present in equal parts by weight two salts as sodium chloride-sodium sulphate, sodium chloride-magnesium chloride, sodium chloride-magnesium sulphate, sodium sulphate-magnesium sulphate, sodium sulphate-magnesium chloride, sodium chloride-sodium carbonate, sodium chloride-calcium chloride, sodium sulphate-sodium carbonate, magnesium chloride-magnesium sulphate. It will be noted that a solution of calcium sulphate was not used. This salt is comparatively insoluble, and a series of tests using it, even in a saturated solution, would hardly be comparable with the series in which the above were used and in which the solutions contained but 2 per cent by weight of the anhydride salts. Moreover, when this solution contained the sulphuric anhydride radical, calcium sulphate would be formed in the cement. The field tests made at Atlantic City are reported in Part II of this paper.

Physical Laboratory Investigation

This investigation, comprising three series of tests, consisted of making of cement mortar, hollow cylinders closed at one end, 3.5" outside diameter, 10" high, with walls and base 0.5" thick, and permitting various solutions to percolate through.

Summary

The conclusions must be limited by the scope of this investigation and since the physical tests reported cover a period of exposure not exceeding 3½ years the conclusions should be considered as somewhat tentative.

1. Portland cement mortar or concrete, if porous, can be disintegrated by the mechanical forces exerted by the crystallization of almost any salt in its pores, if a sufficient amount of it is permitted to accumulate and a rapid formation of crystals is brought about by drying; and as larger crystals are formed by slow crystallization, there [illegible]

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[1] [illegible] 931; also "Experimental researches in the con- [illegible] Michaelis, *Bul. de la Soc. D'Encourag. de* [illegible]

[2] [illegible] 1910. Michaelis, *Tonindustrie Zeitung*, Oct. 9, 1909. Schuljatschenko, Through Cement, 1901, p. 291. Rebuffat, *Gazz. Chim. Ital.* 31, No. 55. Poulsen, Ten Years' Report of the Scandinavian Portland Cement Manufacturers' Association, through *Concrete and Constructional Engineering*, vol. 5, No. 1

[3] Colo. State Agr. Col. Bull. 132, Destruction of Concrete by Alkali

[4] Mont. State Agr. Bull., The Effect of Alkali on Portland Cement

a larger scale, but in greater time if slow drying were had. Porous stone, brick, and other structural materials are disintegrated in the same manner. Therefore in alkali regions where a concentration of salts is possible, a dense non-porous surface is essential.

2. While in the laboratory an hydraulic cement is readily decomposed if intimately exposed to the chemical action of various sulphate and chloride solutions, field inspection indicates that in service these reactions are much retarded if not entirely suspended in most cases, due probably to the carbonization of the lime of the cement near the surface or the formation of an impervious skin or protective coating by saline deposits.

3. Properly made Portland cement concrete, when totally immersed, is apparently not subject to decomposition by the chemical action of sea water.

4. While these tests indicated that Portland-cement concrete exposed between tides resisted chemical decomposition as satisfactorily as the totally immersed concrete, it is felt that actual service conditions were not reproduced, and therefore further investigation is desirable.[5]

5. It is not yet possible to state whether the resistance of cements to chemical disintegration by sea water is due to the superficial formation of an impervious skin or coating, which is subsequently assisted by the deposition of shells and moss, forming a protective coating, or by the chemical reaction of the sea salts with the cement forming a more stable compound without disintegration of the concrete, or by a combination of both of these phenomena.

6. Marine construction, in so far as the concrete placed below the surface of the water is concerned, would appear to be a problem of method rather than materials, as the concrete sets and permanently hardens as satisfactorily in sea water as in fresh water or in the atmosphere, if it can be placed in the forms without undue exposure to the sea water while being deposited.

7. Natural, slag, and other special cements tested in concrete mixtures showed normal increase in strength with age both in sea water and in fresh water.

8. In the form of neat briquettes most of the Portland cements of high iron content, several of the cements of high or normal alumina content and one special slag cement did not show any marked difference in tensile strength whether exposed to fresh or sea water for all periods up to two years. Other cements of various compositions showed signs of disintegration after a few weeks.

9. All cements resisted disintegration in sea water better in mortar mixtures than in the form of neat briquettes. In most cases the mortar briquettes had normal strength up to 2 years' exposure.

10. The physical qualities of the cement, which depend essentially upon the method of manufacture, would seem to determine its resistance to decomposition when brought into intimate contact with the sulphate and chloride solutions.

11. Contrary to the opinion of many, there is no apparent relation between the chemical composition of a cement and the rapidity with which it reacts with sea water when brought into intimate contact.

12. Tricalcium-sulpho-aluminate could not be formed, and therefore disintegration could not result from this cause.

13. In the presence of sea water or similar sulphate—chloride solutions:

(*a*) The most soluble element of the cement is lime. If the lime of the cement is carbonated it is practically insoluble.

(*b*) The quantity of alumina, iron, or silica present in the cement does not affect its solubility.

(*c*) The magnesia present in the cement is practically inert.

(*d*) The quantity of SO_3 present in the cement up to 1.75% does not affect its solubility, but a variation in the quantity present may affect its stability by affecting its rate of hardening.

14. The change which takes place in sea water when brought into intimate contact with the cement is as follows:

(*a*) The magnesia is precipitated from the sea water in direct proportion to the solubility of the lime of the cement.

(*b*) The sulphates are the most active constituents of the sea water and are taken up by the cement. Their action is accelerated in the presence of chlorides. No definite sulphate compound was established.

(*c*) The quantity of chlorine and sodium taken up by the cement is so small that no statement can be made as to the existence of any definite chloride or sodium compound formed with the cement.

15. The SO_3 added to a cement in the plaster to regulate the time of set is chemically fixed so that it will not go into solution when the cement is brought into intimate contact with distilled water.

16. Metal reinforcement is not subject to corrosion if embedded to a depth of 2 in. or more from the surface of well-made concrete.

* * *

319. Coefficients of Expansion

"What are the coefficients of expansion of the common materials of construction, and what is their special significance? How are they applied in [illegible]*"*

319. Discussion

[The following discussion has been prepared by a student in the Extension Division of the Univ. of Wisconsin, and is forwarded by Prof. G. A. Hool, in charge of the engineering work of the Extension Division.—Editors.]

The coefficients of linear expansion of the common materials of construction per 1° F. are as follows:

Concrete	0.0000060
Steel	0.0000065
Brick and Stone	0.0000050
Wrought Iron	0.0000067
Cast Iron	0.0000062

The coefficient of linear expansion (or expansion in length) is the fraction of its length which a body expands when its temperature is increased 1° F. For example, if the temperature of a steel rod of length l is increased 1° F. its length will be increased 0.0000065 times l. Since the expansion is constant for each degree change in temperature, we would have for a change of 50°, a change of length equal to $0.0000065 \times 50 \times l$.

If the rod has one end which is not restrained in any way, there will be no stress in it due to expansion or contraction. If, however, both ends are fixed, then a drop in temperature of 1° F. will cause a tensile stress of about 200 lbs. per sq. in. This value is obtained by making use of the principle that modulus of elasticity of a material is the ratio of the stress per unit area to the deformation per unit of length, or $S = 0.0000065 \times 1 \times 30{,}000{,}000 = 195$ lbs.—that is, assuming the modulus of elasticity of steel at 30,000,000. For a drop of 50° in temperature the stress would be about $200 \times 50 = 10{,}000$ lbs. per sq. in.

This idea has been made use of in buildings where the walls leaned out. A rod a little longer than the distance out to out of walls is used; the ends are threaded and washers of some kind used on the outside. When the rod is in place, it is heated, and, as it expands, the nuts on the outside are tightened. When the rod has expanded the desired amount it is allowed to cool and the walls are pulled in the desired amount by the contraction of the rods in cooling.

In masonry structures the changes due to temperature are taken care of by expansion joints. In steel roof trusses and bridges, the supports are arranged so that the truss is free to move at one end. In laying steel rails the joints are so made that expansion or contraction of the rail is taken care of at these points. Many more instances could be cited where satisfactory design depends upon a knowledge of the coefficients of expansion of the common materials of construction.

* * *

320. Concrete In House Construction and Limestone Aggregate

"We are considering the advisability of erecting a number of concrete houses for laboring men and would like your advice on the following:

> *"First—Would you consider a monolithic or solid poured concrete house too damp for comfort and health?*
>
> *"Second—We have a limestone ledge very near the territory we should undertake to improve with such houses, which could be crushed to furnish the aggregate for the concrete, but we desire to know to what extent, if at all, the fine powdered limestone dust might be used to displace the requirements for sand in concrete work. Could you furnish us a formula for the use of this dust in a mix suitable for house build*[illegible]

320. Discussion by A. Morgan Smith*

The idea that a poured concrete house will be damp when constructed properly is absolute nonsense. The word "dampness" as applied to concrete houses no doubt originated from the sweating of the inner surface of the outside walls that were not provided with a dead air space.

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[5] [illegible] atmosphere. With this condition the sea water [illegible] moisture evaporating and leaving the salts, which would become concentrated, and thus possibly cause disintegration, especially if mixture is porous. An additional series of tests [illegible] in length are being placed in sea water so that 2 feet of the center portion will be exposed to the atmosphere. After various periods of exposure the piles will be sawed and the various sections tested for elastic properties and compressive strength

* [illegible]

Any wall of reasonable thickness whether brick, stone or concrete made solid without an air space if allowed to become cold will condense the moisture from the air in the room just as soon as the room is heated.

Fur the inside of the outside wall for about 1 in. air space and plaster in the usual manner; the walls will be "bone dry" any season of the year. This dead air space insures easy heating in the winter and keeps the house cool in summer. I can safely say that the houses that I have constructed are dryer, easier to heat and cooler in summer than houses of other construction.

As evidence of the dryness of the properly constructed house, the Congress on Tuberculosis held in Washington awarded first gold medal for a sanitary all-reinforced concrete house. If concrete houses were damp they would not have been selected to house patients suffering with tuberculosis.

Crushed Limestone Aggregate

A simple way to obtain the amount of sand to mix with the crushed limestone is as follows:

Place a quantity of the limestone in a vessel of known volume; shake it down and level it at the top carefully; add water from a receptacle containing a known quantity until it reaches the top surface of the limestone, then by deducting the water not used, determine the amount of water necessary to fill the voids. Sand equal to this amount must be added.

By adding sand in this proportion to the limestone with the dust a concrete will be sufficiently strong for the average residence wall. For particular work concrete specifications usually do not permit the fine dust of limestone as it interferes with the setting of the cement and reduces the strength of the concrete; for slab work the dust ought to be taken out.

* * *

321. Using Paraffin Gasoline Solution to Waterproof Concrete

"Will you tell me what grade of paraffin is employed for waterproofing purposes as mentioned in the articles page 87, of the Feb., 1913, issue? Will it dissolve like that in gasoline or is it better to warm it a little, and what proportions of gasoline and paraffin must be employed? What proportions for linseed oil must be used? I have tried linseed oil but without very good results. I believe paraffin will be preferable. Is the result permanent?"

321. Editorial Discussion

This question refers to the practice of the Aberthaw Cons. Co., a brief comment on which was made on the page referred to. L. C. Wason, pres. of the Aberthaw Const. Co., replies to this question advising us as follows:

"We have no special grade of paraffin, but simply use what we buy in the open market. We do not warm it, but cut it up very fine so that it will dissolve readily, and try to make a saturated solution. The same with boiled oil. We add just enough gasoline to it to thin it so that it will flow readily. In our experience the results have been permanent"

* * *

322. "Centering" and "Form Work"

"What is the difference between the terms 'centering' and 'form work,' or 'forms' as commonly used?"

322. Discussion by Sanford E. Thompson*

The terms "Centering" and "Form Work" are frequently used interchangeably. Strictly speaking, however, "Centering" applies more distinctly to arches than to the ordinary types of concrete construction. When we speak, for example, of "striking the centers," we mean, usually, the lowering of the form, or center, which supports an arch.

322. Discussion by E. L. Ransome**

Relative to the terms "Centering" and "Form Work," "Centering" is a term more usually applied to the falsework used in the construction of arches. Owing to the crown of a pipe being usually arched, this term is often extended to the molds used in making monolithic pipe or conduits.

"Form Work" is a term of broader significance and embraces all kinds of falsework set up to give shape to concrete and similar plastic materials.

* * *

323. Keeping Track of Centering Units

"In large reinforced concrete buildings, where the form units have to be framed up ahead of time, what is a good method of numbering or lettering the forms to indicate their position in the work? Would a system of co-ordinating the columns, or panels, much as a map is co-ordinated, be of value? Do you use stencil or free-hand to letter the form units?"

323. Discussion by J. Lorente, C. E.†

When the forms for a reinforced concrete building have to be made a considerable time before the actual setting up, or even when the forms are being made in a neighboring shop as the building proceeds, it is highly desirable to have them so marked that the foreman on the job can tell at a glance the particular place in the building to which each unit belongs.

This is a desideratum which even the structural steel companies, with their highly scientific methods, do not attain. An experienced structural worker by looking at an I-beam or a channel and its mark cannot determine the location of the particular member on the job without consulting very carefully the blue prints. Of course, the blue prints have ultimately to be referred to before a member is set up, but a method whereby a member could tell its own story at a glance would save a considerable amount of time, especially when the different members are brought to the job and have to be placed as near as possible to the place they are permanently to occupy.

There are several methods of marking employed by reinforced concrete construction companies, but as they are, as a rule, mere imitations of the systems adopted by the structural steel companies, they have the same defects.

The writer has used a method, which he believes to be original, and which has given entire satisfaction. Briefly stated, it consists in giving each column a different mark and then referring every form unit back to the columns.

As the columns, or the footings of the columns, are the very first piece of work in a building, the foreman soon familiarizes himself with their positions and, if every unit is referred back to the columns, he has no difficulty whatever in finding the exact location of each.

First of all, the columns should be marked each with a different number, taking them in order along the long rows. Then mark each column form with a fraction, the numerator of which indicates the number of the floor under which the unit is to be placed. The denominator indicates the column to which the unit belongs. In this way 3/5 on a form would indicate that it belonged to column No. 5 under the third floor.

The girders—meaning all beams supported by walls or columns—are likewise marked with a fraction having for numerator, as in the case of the columns and of all the other marks as well, the number of the floor under which the form is to be placed, and the denominator consists of two numbers with the letter G between them. The numbers are those of the columns supporting the girder and the letter stands for girder. Thus 2/5G6 would mean girder under second floor from column 5 to column 6.

The beams are also marked with two numbers and the letter B in the denominator. For instance, 4/5B15 would indicate a beam under the fourth floor from girder between columns 5 and 6 to girder between columns 15 and 16.

This fractional system is applied as far as possible to all the units.

The mark 3/6W7 would mean panel for wall under third floor between columns 6 and 7, and similarly 2/12F22 would mean form for second floor from girder between columns 12 and 13 to girder between columns 22 and 23.

The foregoing remarks will give the reader an idea of the method. It will be seen that each mark gives at a glance the exact location of each unit, without having to look up any blue prints.

As to the actual marking of the forms it may be done either by stencil or free-hand, preferably the former, if for nothing else, because what is worth doing is worth doing well.

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*Architect, Mt. Lebanon, Pa.

**Cons. Engr., Boston

*Cons. Engr., N. Y. C.

†Lynn, Mass.

The extra labor entailed by stenciling is very small indeed, and is fully compensated by the much greater clearness in the marking which saves any possible errors in reading the marks.

323. Discussion by W. P. Anderson*

With reference to lettering form work in concrete building, we simply letter our form work with black paint (lampblack and coal oil), and do not use a stencil. I do not believe that a system co-ordinating the columns or panels in a way similar to that of a map would be of much value in building work as a number of the panels in different sections of the building are of the same size and it is immaterial whether they come back in exactly the same position each time. The way to do is to have a form drawing indicating the position of the different members and giving the same numbers or letters to the panels which will be the same. Then mark panels in accordance with marks on drawing.

323. Discussion by DeWitt V. Moore**

With reference to method of designation of the form units for a reinforced concrete building, where the forms are prepared ahead of the actual concrete construction, I would suggest that the best method is also the most simple. In my mind this result is best accomplished by numbering or lettering each column and each panel of floor construction. By a proper combination of these numerals the location of girder forms is absolutely established and by the use of the panel lettering the floor construction is equally as well taken care of.

Under all conditions I am decidedly in favor of free-hand lettering. It may not be as uniform or as beautiful but it certainly saves time and therefore money.

323. Discussion by J. A. Bryant†

It has been our custom to work from drawings on which all columns were numbered and all girders and beams lettered. The superintendent on the work makes a pencil sketch of the form and length of boxes required, marking on each sketch number of boxes required and the distinguishing mark of the box. The carpenter foreman in charge of making of the boxes is provided with paint-pot and brush, and after completion of the checking of boxes with tape, if found to be correct, gives the distinguishing mark as called for on sketch.

This is the only system of numbering we have used and it is dependent upon a proper working drawing on which all beams of same detail have same mark.

323. Discussion by Chester S. Allen*

In regard to the method of numbering or lettering forms to indicate their position on the work, we have found that most of the large contractors who have executed work for us have used a key plan showing the beams, columns and floor panels, with each individual unit numbered. Each portion of the form unit such as beam side, column side, etc., is numbered to conform to the number on the key plan.

In regard to the use of a stencil or free-hand on the form unit, would state that as a general proposition we have found that it is much quicker to paint the numbers on the form unit with a brush than it is to use a stencil.

* * *

324. Fences for Sidewalk Work

"What is a cheap method of building fences around new sidewalk work? Would it be possible to manufacture a light portable fence, which, while involving a higher first cost, would mean economy and efficiency in the long run?"

324. Discussion by J. D. Carey**

If a fence could be designed with posts that would weigh no more and be no more clumsy in hauling from job to job, than a roll of wire, it would be of some use; otherwise it would be of little good to the average sidewalk man.

In residential sections the contractor finds material for stakes, and down town he finds poles, water plugs, posts, etc., or is equipped with planks. Posts should be made detachable so as to be adjustable to various distances as occasion may require.

* * *

325. Cinder Foundation in Sidewalk Construction

"We would be glad to hear from authoritative sources some expressions of opinion relative to comparative merits of concrete sidewalks with and without drainage foundation, using as a basis for comparison, a 4-in. thick slab of concrete laid on a cinder cushion 8" in thickness, or a 4-in. thick slab of concrete laid on a solid dirt bottom, without any cinders or other provision for drainage. Our own experience has been that the latter method is equally as good as the former, if not a shade better, other things being equal as to material and workmanship, but we should like some expressions from engineers and others in the trade as to which of the methods, if any, is either considered standard, or tending to become so.

"In this connection, we should like to know whether or not it is usual in the case of the cinder foundation being required, to demand that the cinders be passed through a ¼-in. screen, assuming that the cinders are a good grade of factory cinders, with the usual amount of fine material, but free from waste or rubbish. We have been in the habit of using the cinders as they come to us, but we are now asked to screen them through a ¼-in. screen, on the engineer's interpretation of the clause 'clean steam cinders' used in the specifications.

"Is the specification referred to not unusually strict, and arbitrary in general, and if required to be lived up to in its entirety, would it not make the cost of sidewalks laid in strict conformity with it a very expensive, not to say an almost prohibitive, job?

"We should be obliged for your opinion relative to the following terms from the sidewalk ordinance under which we are now working:

'clean steam cinders'

'clean, sharp, screened sand' (used in the concrete)

'covering and keeping moist for three days'

"We are trying to have a change made in the specifications which will allow of good work for less money than is entailed in laying the sidewalks strictly according to sample specification and your good advices, and those of correspondents will be appreciated."

325. Discussion by C. R. Ege*

I do not see how a uniform practice can be established in this matter as there are undoubtedly situations where a cinder foundation or cushion would certainly be necessary and desirable and in other cases it would be entirely unnecessary. The general practice in the State of Washington is to lay a 4-in. slab of concrete directly upon a tamped earth foundation without any cinders or other provision for drainage, except in very unusual conditions.

One matter which might be mentioned in connection with the foundation of concrete sidewalks and which may be of interest to contractors generally, is that we have noticed that where a concrete slab for sidewalk is laid directly upon a foundation which is largely hardpan or cemented gravel, the slab is almost sure to show contraction checks. These checks do not often occur when the concrete is laid upon a loam or sandy foundation. It occurs to us that this is due to the fact that the hardpan foundation does not allow the concrete slab to move when the concrete contracts in periods of low temperature. This would seem to be demonstrated by the fact that some time ago the city of Seattle required concrete sidewalk contractors to tear up and replace any portions of a concrete sidewalk which showed cracks. The contractors soon observed that these cracks almost invariably occurred where the concrete slab had been laid over a hardpan foundation, and the difficulty was remedied by excavating the hardpan to a depth of 1" to 2" below that required by the grade stakes and filling in the extra space excavated with loam or sand. The concrete does not seem to bind so firmly to the loam or sand, and when contraction takes place, allows the slab to move freely over the base, thus eliminating the tensile stresses due to contraction.

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*Pres., Ferro-Concrete Const. Co., Cincinnati

[illegible]

[illegible] Detroit

*[illegible]

**Contractor, Cleveland

*Prin. Asst. Engr. office of Highway Commissioner, State of Washington, Olympia, Wn.

326. Relative Economy in Column Forms

"What is the best and cheapest method of column centering? Is it better to use heavy lumber placed vertically or panels built of lighter lumber placed crosswise? Leaving out the question of the value of the steel forms for columns we want to know particularly if these various proprietary mechanical column clamps advertised are economical as compared with our customary wooden yokes? What data covering cost of actual operation are there available on this?"

326. Discussion by A. B. Loomis[*]

The first work my foreman set me at when I began working at form building, was making up panels for column forms. It is hard for me now (as I look back after years of experience in all branches of concrete work) to realize that anybody could ever have been so foolish as to make them in the way we did at that time.

We used up thousands of feet of good lumber and hundreds of pounds of nails, to say nothing of hours and days of expensive labor to build the poorest kind of column forms. Just think of the absurdity of standing and sawing good clean sheeting up into pieces 12" long and then nailing them onto two pieces of 2 x 4's to make a column side when all you had to do was to take a plank that was 12" wide, cut it the right length and you had a better side than you could possibly build up. It is so ridiculous that it is hard to conceive that a rational being could be so foolish, but that is just the way we did everything else in those days. Like the boy pulled the hen off the nest—by main strength and awkwardness. In fact, when I had been promoted to foreman and put in charge of the construction of a large schoolhouse and built my first columns out of upright plank (which were good for something else when we got through with them there) my engineer, and he was regarded as being an expert in his line, said they would not hold, but they did and made so much better a form and so much more handsome a column when completed that I was never required to build any more of the old style.

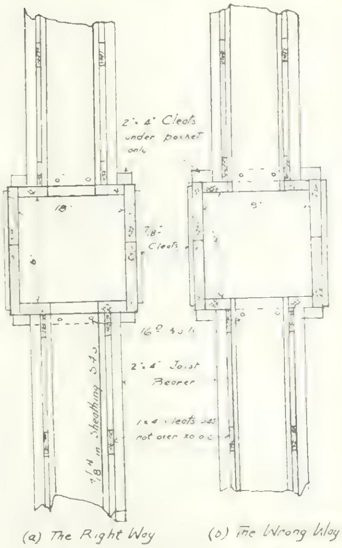


Fig. 1.—Sketch Showing Column Form Details in Plan

A few remarks about the way of cutting the pockets in column sides to receive the beams or girders. I find it is a very great advantage to cut the pockets the neat size of the beams or girders required and let the ends of the beam and girder forms butt against the column forms as shown in *a* of the accompanying sketch (Fig. 1). Do not let them pass through the column forms as shown in *b*, as it is very difficult to tear down the form work.

I also find it a great advantage in ordering my material to try and order it so that I can make my beam or girder pockets by simply cutting off the middle plank of the column side the right length and not to do any ripping. If I have an 8-in. beam in an 18-in. column, I use 2 x 5's one on either side and a 2 x 8 in the middle. Now if my beam is 18" deep all that is necessary to do is to cut the 2 x 8's 18" shorter than the 2 x 5's, adjust it right, nail three or four ⅞-in. x 4-in. cleats to hold them together and my column side is made.

I haven't used the patent yokes enough to be any authority on them.

This all sounds simple enough now, but it has taken years of experience to work out some of these little details that mean much on the success of a job. I am glad to be able to contribute this information, which may be of value to other Concrete-Cement Age readers.

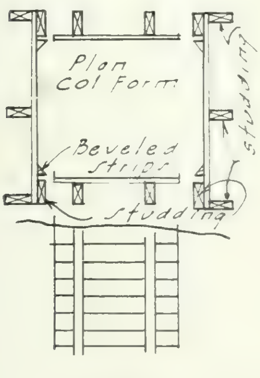
326. Discussion by C. H. McAlister[*]

In regard to column construction and use of collars for forms, we have always considered the number and style of columns to be built in constructing our forms or molds. For a contract including, say, two or three dozen columns only, we have used panels built of light timber placed crosswise (Fig. 2, sketch *A*), this light timber being generally scrap ends of ⅞-in. T and G. With this we have used the plain wooden collars or yokes (as shown in sketch *B*). Economy alone, in construction determines the use of this style of form.

But for any considerable number of square or rectangular columns, it is our opinion that 2-in. dressed lumber placed vertically and well built is the best. In connection with these forms we have used collars as shown in sketch *C*. These collars are easily and quickly placed and removed, and are used indefinitely.

For circular work we have used metal forms entirely, as the cost of wooden construction is prohibitive.

The best class of work we have done has been with 2-in. dressed lumber column forms. They are capable of better alignment, resist the pressure of the concrete much better than lighter forms, eliminate the many joints which are a feature in lighter lumber placed crosswise in column forming and allow of better spading of the faces, because the joints in the form are vertical instead of crosswise.



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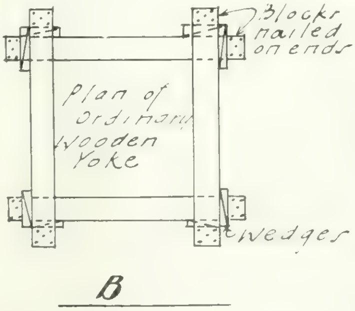

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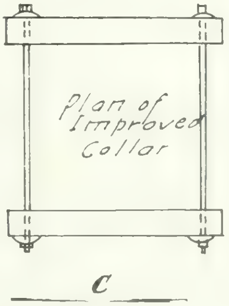

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[*] Const. Engr., John F. Casey Co., Pittsburgh

327. The Highest Concrete Building

"What is the highest concrete building in the country?"

327. Discussion by C. W. Boynton*

So far as we know, the Ingalls Bldg., Cincinnati, is the tallest building of reinforced concrete in the country. This building rises to a height of 210′ above the street level and has 16 floors.

Other reinforced concrete structures which can be classed as tall buildings are as follows:

Thompson & Norris Co., Brooklyn, N. Y., 86′ x 170′, 13 stories high.
Warehouse of Massachusetts Cotton Mills Co., Lowell, Mass. 100′ x 256′, 12 floors high, 8-ft. ceilings.
Warehouse of Arbuckle Bros., Brooklyn. 200′ x 206′ x 162′, 12 floors.
Kent Building, Brooklyn. 124′ x 130′, 125′ high; 11 floors.
Robt. Gair Co., N. Y. C. 219′ x 200′, 133′ high; 10 floors.
Warehouse of Fredk. Loeser & Co., Brooklyn. 70′ x 139′, wing 97′ x 100′, 129′ high; 10 floors.
Warehouse of Deere & Webber Co., Minneapolis. 133′ x 165′, 120′ high; 10 floors.
Sharples Building, Chicago. 74′ x 90′, 130′ high; 10 floors.

* * *

328. Lye and Alum Waterproofing

"Will concentrated lye and alum make a waterproofing compound?"

328. Editorial Discussion

We find that the U. S. Army Engineers have employed a wash of alum and concentrated lye which has been used successfully in many instances. This is mixed in proportion of 1 of lye with from 2 lbs. to 5 lbs. of alum and 2 gals. of water.

This same process, slightly varied, has been used as the Sylvester process of making waterproof mortar. Maj. W. L. Marshall in the Report of the Chief of Engineers, 1901, states that this waterproof mortar can be made by "taking one part cement and 2½ parts sand and adding thereto ¾ lb. of pulverized alum (dry) to each cu. ft. of sand. All of this is first mixed dry, then the proper amount of water—in which has been dissolved about ¾ lb. of soft soap to the gal. of water—is added, and the mixing thoroughly completed. The mixture is little inferior in strength to ordinary mortar of the same proportions and is impervious to water, and is also useful in preventing efflorescence."

* * *

329. Storage Tanks for Oil

"Can concrete be used to build tanks for storing oils, both vegetable and mineral?"

329. Editorial Discussion

In this Department, under Item 233, the question of lining oil tanks was discussed in *Cement Age*, Feb., 1912; under Item 281 in Concrete-Cement Age, the construction of tanks for vegetable oils was discussed. Bearing upon this question in general, and including both mineral and vegetable oils the following references, recently brought to our attention by C. W. Boynton, Engr. in charge, Information Bur. Universal Portland Cement Co., Chicago, are of interest. Past issues of the three journals which have been merged to form Concrete-Cement Age also present many detailed articles on this subject. The following references are from the *Eng. News* and *Eng. Record* only:

Synopsis of Articles Dealing With the Effect of Oil on Portland Cement and Concrete.

"Disintegration of Portland Cement Briquettes by Oil and Experiments to Prevent It." An article by James C. Hain describing a series of experiments undertaken by the C. M. & St. P. Ry. Experiments were made on briquettes of neat Portland cement and on sand briquettes of mixtures of 1:1, 1:2 and 1:3. The results seem to indicate that

(1) Most of the oils penetrate concrete mortar.

(2) It is more liable to be disintegrated when saturated with oils and fats before it has thoroughly set.

(3) A good quality of concrete is less susceptible to the effect of oil than a lean, poorly mixed or unseasoned concrete. In connection with these experiments several structures exposed to the action of engine oils and the like were examined and a limited number were found to be affected by the oil; in these cases the concrete was either very old or the character of the original material and the quality of the workmanship were questionable.—*Eng. Record*, Mar. 25, 1905. Vol. 51, No. 12, page 357. Also *Eng. News,* Mar. 16, 1905, page 279.

A letter referring to the article by Mr. Hain and the results of the experiments described therein. The writer believes it is evident from the experiments that boiled linseed oil has practically no effect on cement, because the outer film, absorbing oxygen, dries the oil rapidly, but states that raw oil will injure concrete that is rich in lime.—*Eng. News*, April 20, 1905. Vol. 53, No. 16, page 418.

"Action of Oil on Concrete." A letter by John Lathrop Gray, Bayonne, N. J., regarding the effects of oil on concrete. He states that he has used concrete for lining the bottom and sides of riveted steel tanks and has also constructed both oil and water tankage of reinforced concrete, none of which after years of service shows any indications of any action of oil on the concrete.—*Eng. Record*, Mar. 2, 1907. Vol. 55, No. 9, page 313.

"Tests of the Effect of Oil on the Strength of Portland Cement Briquettes." A short article giving a series of tables which show the strength of Portland cement briquettes immersed in water and in oil for different periods of time. The results appear to show that after concrete is allowed to set in water for some time before the application of oil, no ill effects need be feared.—*Eng. News,* Aug. 30, 1906. Vol. 56, No. 9, page 227

"Combination Concrete, Brick and Steel Shop Construction, El Paso and South Western Railway." In connection with details of construction of shops, experiments were made preliminary to construction of reinforced concrete tanks for storing fuel oil. The small test tank is built of 1:2:4 concrete and filled with fuel oil to determine the penetration and effect of oil on concrete. At the end of nine months this test tank is still full of original oil. The tank proved absolutely tight, the oil having penetrated and discolored the concrete less than ½ in. The latter is still apparently entirely sound and uninjured.—*Eng. News,* Jan. 3, 1907. Vol. 57, No. 1, page 12.

"The Effect of Oil on Cement Mortar." By R. C. Carpenter.. Describes investigations made in the mech. laboratory of Sibley College, Cornell Univ. and gives tables showing the results of the tests. In connection with the experiments, it is noted that the effect of oil mixed with cement is to retard materially the hardening process; this is more marked with linseed oil than with engine oil.—*Eng. News,* July 4, 1907. Vol. 58, No. 1, page 16.

* * *

330. How to Put on Stucco

"What do you consider the best method to make a good stucco finish direct on a smooth face hollow block wall?"

330. Discussion by L. R. Ferguson*

In applying stucco to a smooth faced hollow block wall, the exposed surface of the block should first be thoroughly cleaned of all loose and foreign material, and if possible, the mortar between the joints should be picked out to a depth of about ½ in.

Before applying the stucco, the face of the block should be thoroughly saturated with water. This does not mean simply sprinkling with a hose, but means that the block should be wet to such an extent that they will not draw from the plaster the water which has been used in mixing it.

A coat of plaster should be spread over the surface to a depth of about ⅜ in. to ½ in., and if this is not sufficient to remove the irregularities of the surface, a second coat of about ¼ in. thickness should be applied, as soon as the first coat has become firm. If a second coat is necessary the first coat should be thoroughly scratched with a tooth-shaped tool while it is soft.

The mortar for the stucco should consist of 1 part Portland cement, not more than 2½ parts of well graded sand, to which, if desired, may be added immediately before using ⅓ part of lime putty to each part of cement. By lime putty is meant either hydrated or lump lime to which water has been added in sufficient quantity to make a stiff paste.

The sand and cement should be mixed dry until the mass is of uniform color, and then sufficient water added to obtain the desired consistency.

If lime is added, care should be taken to see that it is uniformly distributed and the entire mass is uniform in color and homogeneous.

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*Engr. in Charge Information Bur. Universal Portland Cement Co., Chicago

*Assn. of Am. Portland Cement Mnfrs., Philadelphia

Uniform Material Essential.

Care must be exercised to make each batch exactly the same if the work is to produce a uniform appearance over the entire surface. Not only must each of the ingredients be measured with exactness separately, but the amount of water also in each batch must be carefully measured.

The plaster should be spread evenly over the saturated face of the block, the work being carried in one general direction and made as continuous as possible. If the surface is so large that a joint must be made, this should occur at some natural division in the wall. Care should be taken to avoid the drying out of the edges of the plaster. Troweling sufficient only to bring the mortar to an even sufrace should be done.

The second coat, if one is necessary, should be spread over the first coat as soon as possible to a depth of ¼ in. Care should be taken to protect the finished coat from drying out too rapidly. This can be done either by frequently sprinkling the surface after the mortar has become sufficiently hard to do so without pitting, or by hanging strips of wet carpet or burlap in front of the wall, and keeping them wet.

Care should be taken not to overtrowel the work, as this has a tendency to bring the finer particles to the surface and cause crazing.

Alternate Finishes.

A number of different finishes can be secured, such as a smooth surface by means of a metal trowel; or a sand-float finish by means of a wooden float; by the addition of a little sand after the mortar has partially set; a scrubbed surface by means of a stiff broom after the surface has become fairly hard. This latter finish is particularly effective if in place of sand, marble screenings with the dust removed have been used. There are several other finishes which might be used, such as rough-cast, pebble-dash or rubbed.

If it is desired to color the stucco, a number of different tints can be secured by adding to the dry cement and sand before the water is added such pigments as carbon black, ultramarine blue, red oxide of iron and yellow ochre, but not more than 6% of the weight of cement should be mixed with the plaster. Here also care must be used to insure exactly the same amount of coloring matter being used with each batch.

If the surface of the block has been painted or if they have been covered with oil, it would probably be necessary to use expanded metal placed on furring strips, securely fastened to the wall. These strips should be placed from 12" to 16" apart and covered with expanded metal attached to them by means of staples. Care should be taken to force the first coat through the metal lath so that a key is formed at the back and the lath is thoroughly embedded in the mortar.

331. Cement Grout in Oil Shafts

"In this country there are thousands of oil wells. The formations are varied, mostly shale and clay, with strata of lime. We now propose sinking wells where the principal formation is soil and clay. In many places no rock of any character is encountered at all, even at 1,000 ft. depth. The difficulty is that after, say 100 ft., the walls above where the tools are working will give way and cave onto the tools. Usually the water used with the action of the tools leaves a smooth mud wall which will stand until the well is finished and the casing is inserted, or until either sand or rock is struck and the casing placed in to that depth. Then the smaller tools, etc., work inside this casing to the lower depth.

Now, what we are seeking information on is:

1st—Can we make a thin cement mixture and use instead of water alone? Would the cement be forced into the wall sufficiently so that when the bailer lifts out the product of mud and cement, the cement left on the wall would set sufficiently to stand while the bailer was lifted out, emptied, refilled and returned and proceeded to go another screw length in depth, about 6 ft.?

2nd—What mixture would you make? What is the probable quickest time possible for it to set? Is any special make of cement necessary? Do you think it would penetrate the walls of the hole (6" at bottom to 13" at the top) to hold a soft or caving foundation? So as to make the best possible time in drilling, the time consumed in drilling a 6 ft. scew and bailing out would require from 20 min. to 30 min. Could the cement be made so as to set in that time?"

331. Discussion by Benj. K. Stroud*

The scheme of cementing off the walls of the hole as drilling progresses is not at all feasible because:

1. The cement cannot be dumped or placed in the hole except in a body: that is, it would be impossible to place it so as to leave a hole to drill through, at the same time cementing up the walls.

2. The cement will become united by action of tools and bailer with the clay or soil, thereby preventing its setting. (Hole must be clean for cement to set properly.)

3. If cement were dumped in, what would prevent its being withdrawn by the bailer?

4. If it were to set, the hole would be plugged, requiring drilling out of the entire plug.

5. Cement would not penetrate the walls, but simply adhere to them.

6. The above conditions are not favorable to cementing, no matter how rapid the set or the quality of cement, because of an excessive percentage of debris.

Remedy—

Mix up a sufficient quantity of stiff clay, pump it into the hole to bottom with a steam pump. Clay should be as thick as possible. Insert casing, one length at a time as drilling progresses. (This would require the use of a calf-wheel, which is easily installed). These conditions obtain in California, and are not considered out of the ordinary: in fact, all we have is a caving shale and clay. When the hole caves so badly as to stick the casing, the above method of pumping in clay is advisable.

An oil-saver can be used in connection with the steam pump when using clay, so that drilling can be carried on at the same time.

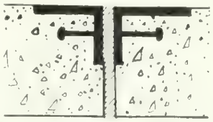
* * *

332. Metal Joint Protectors for Concrete Roads

"Wouldn't an angle iron joint protector be an improvement in concrete road construction—something like the accompanying sketch?"

332. Editorial Discussion

The chief objection which at once suggests itself is that such a joint protector might be too protective—in other words, it might not wear evenly with the concrete. Such a joint was tried out on some of the earliest concrete roads built in Wayne county (Mich.) and the Baker plate[1] now used exclusively in all Wayne county work is found to be better at less expense. Edward N. Hines, of the Road Commission for the county, says he sees no reason for a change; that the angle iron joint is more difficult to place with its projecting lugs or bolts properly embedded.



Cross-Section, Proposed Concrete Pavement Joint Protector

T. R. Agg, Acting State Highway Engineer (Ill.), in the absence of A. N. Johnson, writes that his observation of similar construction plates used for other purposes has been that the concrete wears more rapidly than the flat surface of the plate.

F. P. Wilson, City Engineer, Mason City, Ia., writes: "I do not know of such a joint in use anywhere. A straight plate with a shear member or ties out from the plate is better, used on the sides of the joints. An angle iron can not be expected to wear evenly with the concrete."

H. J. Kuelling, county highway commissioner, Milwaukee county, Wis., writes: "I do not know of such a joint having been used. I believe the joint would be costly to construct, difficult to erect and that it would not wear evenly with the concrete, due to the considerable amount of steel exposed. In general, such a joint would have no advantages over one with only the vertical leg and the anchor sections. Frankly, I would not care to try such a joint."

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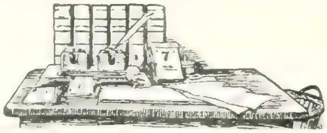
*Universal Oil Co., Wasco, Cal.

[1] R. D. Baker & Co., Detroit



CORRESPONDENCE

The following letters are in the main good short snappy stories of what is doing in the concrete field, and how it is done. Such letters are really short, informal articles sent in from South Africa, from Colorado, and from many places nearer home.

Concrete Bridges in the Dayton Flood

To the question, "How did concrete structures withstand the 1913 flood?" let me quote from a pictorial history of the great Dayton flood, published by the United Brethren publishing house. Speaking of the bridges within the corporation of the city of Dayton, it says: "Of our six bridges spanning the main stream, the Miami river, the form steel concrete (Melan) structures held like adamant. The structural steel Fifth St. bridge and the railroad bridge were carried down." Besides these, parts of the steel bridge over the Miami at White City had two spans washed away, and the steel bridge over Mad river was also carried down. The county outside of Dayton lost some 20 bridges.

The structural steel bridge over the Mad river which went out is to be replaced by a steel and concrete structure now under contract. About 1,000 ft. below the Webster St. bridge the Mad river enters into the Miami and at 2,000′ distance we have the first concrete bridge, spanning the Miami. It was the first one of the four to be erected. A large amount of debris was lodged against this bridge and the water swept over its top. Fig. 1 gives view of this bridge. One thousand, two hundred feet further brings us to the Dayton View bridge. It is said that two-story houses swept out of River Dale struck this bridge and were ground into kindling by the impact. Two thousand five hundred feet further is the Third St. bridge and next to this came the steel Fifth St. bridge which went out entirely. Next to this is the railroad bridge, two spans of which went out. Below this is the Washington St. bridge, shown in Fig. 5. The railing is shown torn away; this was done to allow wreckage dumping by clean-up gangs and was not the result of the flood. Down stream 5,000′ is the stewart St. bridge, not in use, as the approaches had not been completed.

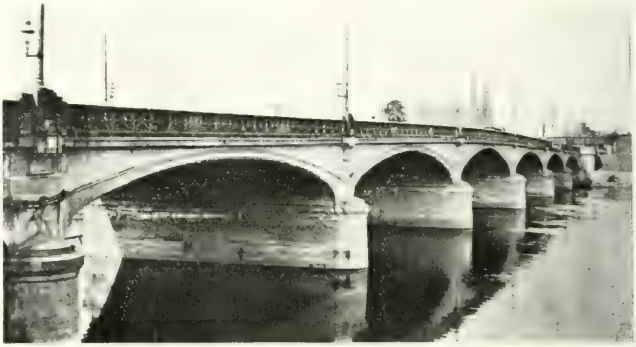


Fig. 5. The Washington St. Bridge After the Flood

At the right is shown a section of the railing broken away. This was not done by the flood, but the opening was made to allow the clean-up gangs to dump materials

Jos. E. Waltz

Dayton, O.

The Development of Concrete Members

The letter in your June, 1913, issue[1] referring to the possibilities of making standard parts for house construction out of reinforced concrete, recalled a conversation I had a year ago with a prominent contractor who said that the one great need of the building industry was seasoned concrete joists of standard sizes, kept in stock for ready delivery.

He remarked that he had talked to a

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[1] P. 295. Letter from L. C. Emerson, Evanston, Ill.

Fig. 1

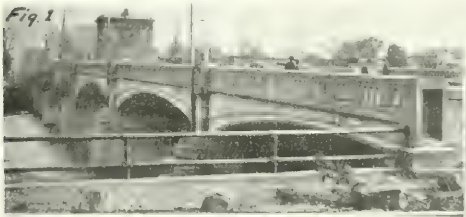


Fig. 2

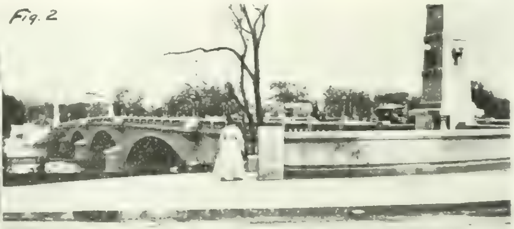


Fig. 3

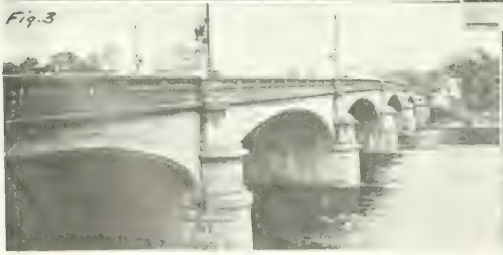
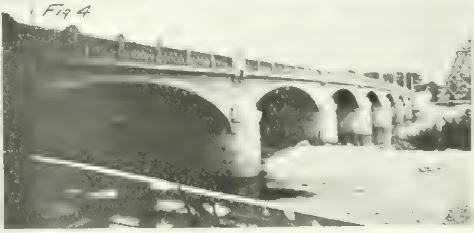


Fig. 4



[illegible] Fig. 2. The Dayton View [illegible] North of Upstream [illegible] Fig. 4. The Stewart St. Bridge After the Flood.

number of concrete workers who had ample facilities to make and store them but it seemed as if they were blind to a great opportunity.

The point he made was that a house, no matter how inflammably constructed otherwise, needs fireproof joists to prevent collapse of the floors and in many cases to save valuable property from going into the cellar.

While not directly interested in concrete work, I know enough about it to believe that the making of joists could be carried on with profit.

To attach wood flooring to them is a matter of detail easily arranged, but it strikes me that in connection with the concrete joists it would be practicable to provide also concrete slabs for the floor by which means the building could be made in combination with brick or stone walls,[2] absolutely fire proof.

It has always seemed to me absurd to build wood molds for each part of a building by expensive labor and up in the air as is done under the "poured" method, when all the parts could be made in permanent molds by factory labor and put into place fully seasoned.

If some enterprising concern among the concrete workers will devise a simple system and put it into practice it will create a revolution in house building methods very beneficial to the public and certainly very much to the profit of the cement workers.

The publication of expressions by you on this subject would be very interesting and instructive.

George B. Harvey.

Kansas City, Mo.

Storing Coal Under Water

We have just completed our sub-aqueous coal storage bin. The bin is 100′ x 300′ by something more than 20 ft. deep, below water line. We can store about 15,000 tons of coal under water and about 15,000 tons above the water. The concrete on bottom and sides is 1′ to 18″ thick, reinforced with twisted steel. The bottom has, in addition to the twisted steel, a system of T-rails so laid that the top of the rail stands ½″ above the surface of the concrete. These rails are 18″ o. c., laid lengthwise in the bin. This is to protect the concrete on bottom from being destroyed by the bucket when scraping for coal.

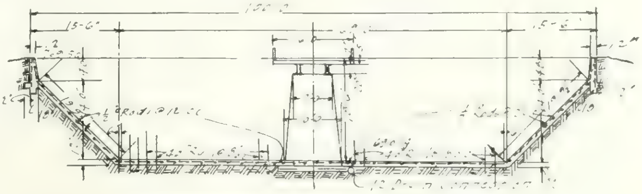


Fig. 1—Section of Coal Bin for Under Water Storage

We have installed a track through the center of the bin on a level with the surface of the ground or something more than 20 ft. above the bottom of the bin.

We shall handle coal to and from this bin with a Brown Hoist locomotive crane,[1] which we have recently purchased. We can also dump a great quantity of coal in the bin without handling.

The bin cost in the neighborhood of $28,000.

Thos. A. Wynne
Vice Pres. Indianapolis Light & Heat Co.
Indianapolis

Concrete in South Africa

I introduced reinforced concrete on the new Standard Bank here and it will be a beautiful piece of work when completed. The dome is a 21-ft. span carried on cantilever beam 42 in the clear and will be a credit to all concerned when completed.

On this job the whole of the floors and columns are being put in of concrete. We are using a Ransome mixer about 10 years old, ¾-yd. capacity, and I introduced a skip and hoist (Yankee, of course) and surprised some of the local builders here with the quantity and quality of reinforced concrete we handled in 9 hours. (There is nothing like serving 10 years under Uncle Sam to teach a man how to handle men and material.)

I recently completed the new Anatomy Bldg., South Africa College, Cape Town, under the Cape Government, and new High schools at same college, both in reinforced concrete.

The labor on this edge of civilization is principally Kaffir, and they are paid $2.50 per week and no "skoff," and sleep on any old place around the job. White men are on the mixer, hoist and laying of reinforcement and concrete.

The new Parliament building, Pretoria, and Johannesburg Town Hall are

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[2] Or concrete, preferably—Editors.

[1] Brown Hoisting Mach'y Co., Cleveland

[illegible]

well under way and have a large amount of reinforced concrete construction in them. I understand they are using local Pretoria cement.

A company for the manufacture of cement has been floated here and will erect machinery very soon. Cement in Bulawayo costs $11.28 a cask, crushed granite $2.60 to $4.00 per yard, sand $1.78, sheeting from 5c to 10c per superficial foot at the mill.

A. Montgomery

Bulawayo, Rhodesia, South Africa

* * *

Magnesium Chloride Concrete Material

I have read Mr. Edward's article in the April, 1913, issue with considerable interest and pleasure. The facts and assertions as set forth in this article by him, we find, coincide with our experience in every particular.

His statement that with proper care and knowledge very satisfactory floors can be made with magnesite cement is true. They give the greatest satisfaction where the composition is right and where the proper care is taken in the installation.

There are more worthless composition floors on the market than any other class of building material, to our knowledge. Companies claiming to have full knowledge of the manufacture and installation of materials of this kind spring up as mushrooms in the night. They usually succeed in convincing a number of architects, contractors and owners that their material is all that they claim for it, claiming that it is superior to anything that has been manufactured, and offering to take work at about one-half the price asked for a good composition. The result is usually about the same, that is, the failure of the floor, disappointment to the owner and in a short time the failure of the composition floor company.

A very important fact if the composition is right is that the finishers handling the material shall have experience in this line of work. It is also necessary for the finisher to take a personal interest in the installation, as the composition material is difficult to handle. Where we have been compelled to sell our material f. o. b. cars Chicago, trusting to the mechanics supplied by the general contractor or owners to make the installation, about 50% of these jobs were not satisfactory, due entirely to the fact that the mechanics who laid the work did not give the finishing sufficient careful attention and have ruined the floor in consequence of their carelessness.

The subject is so well covered by Mr. Edwards in his article that there is practically nothing further for us to say on the subject.

Franklyn P. Muller

Chicago

Concrete Handicapped by Misrepresentation

[Note:—In the Mar., 1913, issue, p. 126, under Consultation Question 297, a western builder stated that he was figuring on 15 five-room cottages for a local coal company; concrete was specified and he wanted some information on forms and equipment for such work. The question was discussed in that issue by C. R. Knapp, of Albany, N. Y. Later on we wrote the western builder, to learn how matters were progressing, and the two following letters, in reply to our inquiry, bring out in a striking manner, how concrete construction can be handicapped by placing the emphasis on relative cost instead of relative value.—Editors.]

You ask about the miners' houses that I wrote you I was figuring on. Well, they are not built yet and I doubt if I will build them of concrete. I think great damage is done the concrete industry by manufacturers of equipment who represent that concrete wall can be built cheaper than frame. Take my own particular case. Most coal camp houses here are built of novelty siding on the outside of a frame, lathed and plastered on the inside. They are cheap! Oh, yes! A four-room house 24' x 24' can be had finished and painted for $450. Of course, the wind blows right through them. But they keep off the rain (mostly) and miners will live in them and pay rent for them.

And then the coal operator picks up some magazine and sees that with some particular mold, or forms, or block machine "concrete houses can be built cheaper than frame."

That looks good to him, especially that word "cheaper." So off he goes to the concrete man with his plans. And the concrete man looks up all the different forms he ever heard of and figures how he can cut down his labor bill to the last cent (if he has the good of the business at heart, he won't steal on cement), and tells the operator that he can give him a good plain job, no fancy work, just as plain as possible but *good* for $500. And Mr. Operator goes up in the air and proves by all the steel form ads in the country that concrete is cheaper than frame. And Mr. Cement Man has made an enemy of one who ordinarily might give him a good deal of work. "He tried to hold me up" is the charge. You may talk "better" until your tongue is tired. It is that word "cheaper" that caught his eye. Of course, he knows they are better.

And to get the jobs some men will take them for less than frame. Coke breeze is cheap and rather clinging stuff, and it doesn't take much cement to hold a wall up until you get a settlement with the company, if you hurry. It looks fair and is guaranteed (?) good concrete. Of course, rain goes through it as if it were a sponge and then the miners say: "Concrete houses are no good."

The plainest kind of *good* concrete houses cannot be built for what the cheapest kind of frame houses can. *Not yet.* Not in these parts. And any advertiser who makes such a statement is making trouble for the cement man.

* * * * *

A Later Letter

You can easily see that I had a "grouch" when I wrote the former letter. It is rather trying, to say the least, to figure concrete down to the last possible cent, make your price and have a man say: "Humph! I can get *frame* houses *way* below that."

Of course he can. All that concrete displaces in outside walls is siding, studding and lath. Either wall must be plastered inside, and outside dressing of the concrete wall will cost as much as the two coats of so-called paint used on these houses.

I can put siding studding and lath in place for 8½ cts. per sq. ft. of wall and do well at it. One cu. ft. of concrete will make 1½ superficial sq. ft. of 8-in. wall. To meet the cost of frame, that would have to be put in place for 12¾ cts. Show me the man who can do that with cement at $1.75 per bbl.; net f. o. b. cars, gravel 75 cts. per yd. and common (very) labor $2.00 per day. In interior walls the figures are worse yet.

L. S. Lester.

Walsenburg, Colo.

* * *

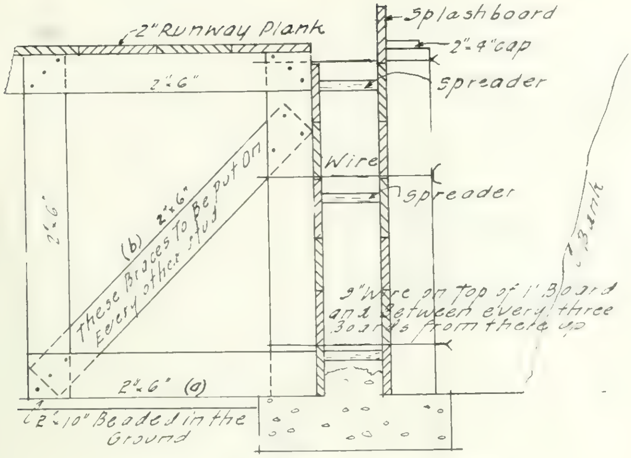
Notes on Wall Centering

I am enclosing you sketch of the way I build a concrete wall form. Do not use any check pieces, but use 2" x 6" studs and ⅞" x 8" s. 4 s. material for sheeting. Have the 2 x 6's cut to a uniform length for upright studs and cut all the sheeting in even lengths of 10', 12', 14' or 16'. Lay the 2 x 6's on the ground with the ends approximately on a line where the wall is to be built. Nail a ⅞" x 8" sheeting board on the edge of the 2 x 6's with the edge of the board flush with the end of the 2 x 6's. Space the 2 x 6's uniformly, not over 20" o. c., but try and have the spaces uniform and the same on the forms for the opposite sides so they will come as nearly opposite each other as possible.

After nailing the bottom board on, nail a temporary board through near the top, having first marked it by laying it at the bottom of the 2 x 6 studs, already nailed, and mark each side of each stud. This will bring the studs all parallel.

On the first panel it will be found necessary to put a stud flush at one end and have the boards meet about the middle of the stud at the other end, and then every time leave off the stud at that end, so the board will nail on the stud of the first panel, the ends of boards butting together.

Raise the panel skeleton up and tack temporary braces and ties on them to hold them approximately in place while wiring. Do not try to line up the forms until after they are tied together for the entire length. Cut spreaders as accurately as possible for the desired



Splashboard
2"-4" cap
Spreader
2" Runway Plank
2"-6"
Wire
Spreader
2"-6"
(b) 2"-6"
These Braces to be put on Every other stud
9" Wire on top of 1' Board and Between every three Boards from there up
Bank
2"-6" (a)
2"-10" Beaded in the Ground

Sketch Showing Arrangement of Wall Centering

thickness of wall. Put a No. 9 wire around the opposite studs and over the top of the bottom board, using temporary spreaders between the top of the forms and permanent ones directly below the wires and twist the wires tightly. Then lay the boards in on the wires so that the men can walk between the form sides, leaving one board on the wires until the form is completed and cleaned out ready for the pouring. On the inside, the first board above the bottom row of wires should be left off for the purpose of cleaning out and straightening forms, and at the final end, put back in place, being sure the space left for it is of the correct width.

Then nail in four boards ⅞"x8", through the length of the forms on each side and tie wire with spreaders just below wire. Put one wire (well tied and twisted tight) and spreader to each pair of studs.

Proceed in this manner to the top, removing the temporary spreaders as you come to them. After the form is tied together clear through, anchor each end firmly in place and stretch a line offset ⅞" through on the inside as close to the ground as possible, so as not to have it touch anything, and with a light crowbar spring the form either in or out until the form is everywhere ⅞" distant from the line. Drive a solid stake a few inches away from the forms and right opposite every other 2"x6" stud; nail a little cleat from the bottom of the stud to the stake, being very careful to get it close down to the ground. Bed a 2"x10" or a 2"x12" plank firmly on the ground about 8 ft. or 10 ft. away from the wall and parallel to it, spike a 2"x6" on the bottom of the 2"x6" stud as shown by piece marked *a* in the accompanying sketch. Then spike on the brace piece marked *b*, shown in sketch, taking care to bring the form right to the line before nailing, thus making a "figure 4" brace. Put one of these on about every third stud. Be extremely careful to pick out straight planks for the inside runway planks and let them come over the top of the 2"x6"s and spike into them. This helps very materially to hold the form rigid.

If these directions are followed closely and a little "gumption" used, one can put up a very straight and handsome wall at a very low cost.

A. B. Loomis

Bldg. Supt., Cleveland

A Refrigerator Built In the Ice House

Recently an Iowa farmer demonstrated a practical use for cement; one that should be adaptable for every farmer living within a reasonable distance of a good sized body of water.

This man had used cement in many different ways on his farm on which he has passed his entire life of more than 50 years, but the idea of harvesting his own ice did not come to him until late in life. Living within a mile of a splendid river, he had formed a habit of driving four miles to town for ice and paying 40 cts. per cwt. for a product that went to waste on his own land.

Recently he built a generous ice-house 60′ from his kitchen. On the south end he made a refrigerator that would turn a city woman green with envy, for there was no cleaning after ice men, no worry about the drip pan or the ice giving out.

The refrigerator was built of solid cement, 7′ high, 6′ wide and 5′ deep. Into the end walls, heavy iron hooks were cast high enough to allow a quarter of beef to hang without touching the floor. In the side, iron pegs were placed for the support of shelves on which to store foodstuffs and the products of the dairy. The ice is packed around and above this roomy ice box, so the housewife has no concern aside from placing her viands on the shelves.

Utilization of Waste Road Space

It has been very truthfully said that this is an age distinguished for its utilization or elimination of waste. Consider country roads. The general width of a "right-of way" is 66′. Of this 66′ the road proper, with the ditches, occupies from 12′ to, say, 22′. That leaves two-thirds of our "right-of-way," or five and one-third acres per mile, unutilized in any beneficial way. In fact, since many roadsides are usually a mass of weeds, whose seeds are blown and carried onto neighboring farms, they might be said to be an active agent for harm to the community. In Europe, the better roads are laid out with grass sown on either side and in many places fruit trees, whose products, handled by the government, go a long way towards paying for the up-keep of the roads. Very few people would consider it possible in America ever to grow fruit trees by the roadside and expect to harvest any products. Sad to relate, it would probably be looked upon by the traveling public of this continent as some philanthropic scheme for the ease and benefit of their gastronomic proclivities. It would still leave unsolved the problem of utilizing waste roadsides in this country in some economically beneficial way. Unless, however, one can devise such means, the returning or renting (fencing off, if necessary), of unused portions of our country roads to those who will cultivate and put them to beneficial use, their ownership becomes a serious responsibility. Consider an ordinary township, divided into 36 sections, with a 66-ft. road allowance between, the road acreage amounts to 572.4 acres. If one allows 22 ft. for actual width of ditches, etc., then there is left two-thirds of the acreage, or 382 acres, of land wasted per township. Figured out, it would probably be within facts to state that 10,000,000 or 20,000,000 acres will be lost as productive land to the communities of Canada and the United States if the side widths of road allowances be not utilized.—*Canadian Engineer.*

A new plant is now under construction at Asbestos (formerly Fitchburg, Md.), for the Baltimore Asbestos Roofing and Mfg. Co., which is removing its plant from Oil City, Pa. It is essential to have an absolutely dry building, and plans were drawn by John B. Hamme, York, Pa., for hollow tile, but after thorough investigation by the officers of the company it was decided as a matter of economy and permanency to use the Redman[1] concrete hollow wall system for the exterior walls.

The walls will be 12" thick with 4-in. air space. The roof structure will be carried by 8-in. I-beams cast in the walls. Asbestos roofing of the company's own manufacture will be used.

The entire plant will be 54′ by 800′, but will be built in units of 200′, 300′ and 300′ respectively as required for the installation of the machinery.

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[1] W. F. Redman, Brentwood, Md.

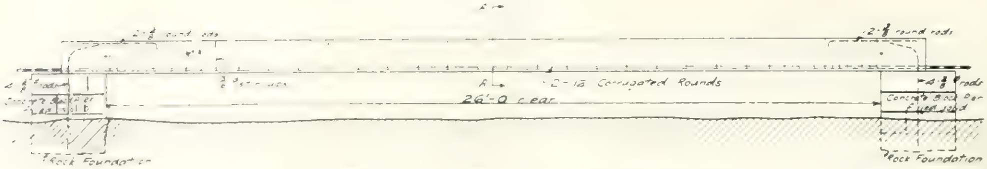

Fig. 1—Side Elevation of the Slabs Used in Test of Concrete Tile

Interesting Tests on Concrete Tile and Joist Construction

Concrete tile, made on the job, using a dry mix, offer effective cores for concrete floors

In the July, 1913, issue, p. 21, a new concrete tile developed by White and Co., Spokane, was described. At an official test made in Spokane June 27 last, the fact was established that a floor slab made with the White system of concrete tile would sustain 11% more load than a similar slab of solid concrete having the same dimensions for joists and top slab. The accompanying illustrations, Figs. 1 and 2, show the design for both test slabs, which it will be noted are identical in the amount of reinforcement which they contain and in the concrete sections. In the solid slab, all of the concrete was poured at one operation, while in the concrete tile slab the larger part of the concrete was in the form of the tile, the poured concrete being used principally to unite the tile and the reinforcement together. It will be noted that the concrete tile slab was heavier because of the 1½-in. bottom flange of the tile. This additional weight amounted to 700 lbs., by which the total dead load of the concrete tile slab was greater than that of the solid concrete slab.

Testing Details

The tension reinforcement for each slab consisted of two 1¼-in. corrugated[1] round bars of medium open-hearth steel. The anchor bars were two ⅜-in. plain round rods hooked at either end, this reinforcement being made very light in order to make the test correspond as nearly as possible to the condition of a non-continuous slab.

The concrete tile were made by the dry tamp process two weeks before the slab was poured. In this process, collapsible inner and outer molds were used which were filled with a 1:6 mixture, the inerts composed of sand and aggregate (aggregate not exceeding ½" in size). The mixture was used just damp enough to give the necessary setting qualities to the cement and the molds were removed as soon as they were filled, leaving the tile on wooden pallets by means of which they were handled until they had been cured. With the type of form used, two men could make 100 tile in a day of 8 hrs.

As the test represented actual slabs to be used in the public schools of Spokane, the upper ¾" of cement finish for both tests was applied monolithic with the slab and was included in the depth in designing the reinforcement.

The slabs were poured with a 1:2:4 concrete composed of Portland cement,[2] sand and screened gravel. The forms were removed after two weeks and the deflection for both slabs was 1/16".

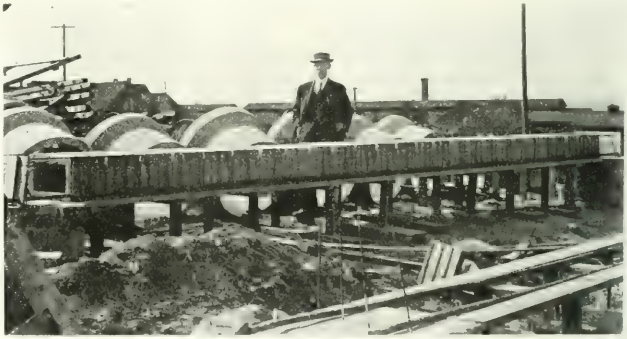

Fig. 4—The Tile in Place Ready for Pouring the Slab Shown in Fig. 3

Design Details

Each slab was designed for a live load of 75 lbs. per sq. ft., using stresses of 16,000 lbs. in steel and 650 lbs. in concrete. The test was made 30 das. after the slabs were poured. The load was applied in the form of sacks of cement weighing 95 lbs. each in layers containing 23 sacks, two layers being equivalent to the designed live load of 75 lbs. per sq. ft. The sacks were placed in three separate piles, leaving an opening of 1' between the piles to prevent any possibility of arch action. This is shown clearly by illustrations of the test. Deflections were read on each side of each slab at the center and the average of the readings used in the tabulated results.

Log of Test

The solid concrete slab was loaded first and failed under a total load of 34,400 lbs. The failure was sudden and seemed to result primarily from crushing of the concrete at the center, the steel elongating in the usual manner for medium steel. After the slab had failed, three large diagonal shear cracks were observed at the left hand end of the slab, evidently caused by the impact of the falling load as the slab struck the ground.

The concrete tile slab was loaded in

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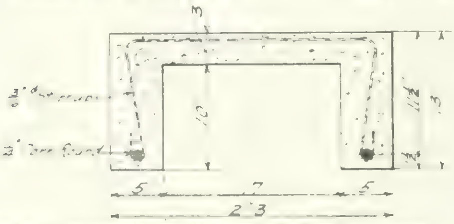
[1] Corrugated Bar Co., Buffalo, N. Y.

[2] Inland Portland Cement Co., Spokane.



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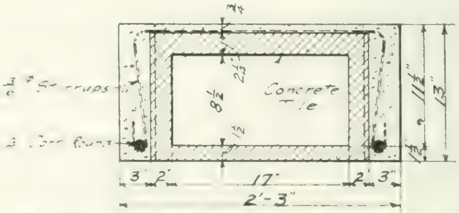


Fig. 2—Typical Section of Combination Concrete Tile and Joist Slab

the same manner as for the solid concrete slab and, at a total load of 38,275 lbs., failed by crushing of concrete at the center. The failure was more gradual than for the solid slab, and the slab settled to the ground so easily that none of the cement sacks in the piles which were 15 layers high fell off. There was no evidence of diagonal shear cracks at either end of the slab after failure.

The accompanying tabulated list of deflections is of interest in showing the uniform elasticity of the concrete tile slab as compared with the variable elasticity of the solid concrete slab, and the effect of tension in concrete on deflections. The successive increments of deflections as tabulated from 75 lbs. to 300 lbs. live load show very clearly this effect. It is to be noted that for the solid slab these increments, which should be equal for a perfectly elastic beam, vary from .14" to .39" and for the concrete tile slab from .19" to .275". The first two deflections for the solid slab are largely influenced by the tension in the concrete which had but little effect in the concrete tile slab due to the joints between the tile.

Comparing the deflections at 450 lbs. live load shows that of the concrete tile slab to be .46" less than for the solid slab. The reason for this is that the dry mix, end tamped concrete of the concrete tile has a much higher modulus of elasticity than the poured concrete of the solid slab.

The entire test, including manufacture of tile and pouring of slabs, was under the supervision of A. D. Butler, Asst. City Engr. of Spokane. Among the 60 or more who witnessed the tests were, J. W. Strack, Co. Engr., Spokane Co., and Co. Commrs. Allan Scott and Joseph Bishop, the latter being interested as concrete tile has been specified in the new Trent Rd. viaduct for the county. The saving in dead load effected by the use of concrete tile on this particular viaduct is estimated to be over 100 lbs. per sq. ft., and the saving in cost of the viaduct over 10%.

Besides being adapted to bridge work on account of its strength and lightness, concrete tile should find a wide application in fireproof buildings of every kind and can be used, as illustrated in the accompanying cut, to give a flat ceiling without projecting caps or brackets of any kind. This form of construction is especially adapted to schools and public buildings, as the tile can be made of any depth and spans as large as 35' or 40' can be readily formed with a flat ceiling. Concrete tile is now specified for a school in Brewster, Wn., and a store building in Tonasket, Wn., on which Keith & Whitehouse, archs., Spokane, are taking figures. For both of these buildings the tile will be manufactured on the site, which effects a large saving in freight.

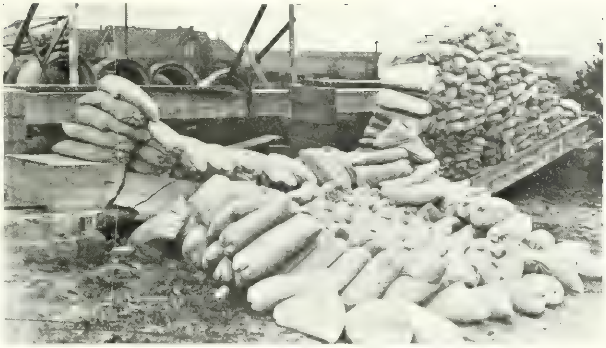


FIG. 5 THE MONOLITHIC SLAB AT FAILURE
The concrete tile slab is shown in the background

The advantages of concrete tile construction, briefly summarized, are as follows:

Eleven per cent greater strength than monolithic construction[3];

Simplicity and economy in centering (open centering with planks under each joist is all that is required);

Speed of erection;

Saving in dead load from 30% to 100%;

All-concrete flat ceiling provided, which in many buildings requires no plastering;

Saving in freight rates in transportation;

Providing a product which can be manufactured in *any* locality and which has a wider range of usefulness than terra cotta tile.

Detailed observations made in connection with the test of June 27 are shown in Table I:

TABLE I DETAIL NOTES OF COMPARATIVE TEST ON CONCRETE TILE AND MONOLITHIC CONSTRUCTION

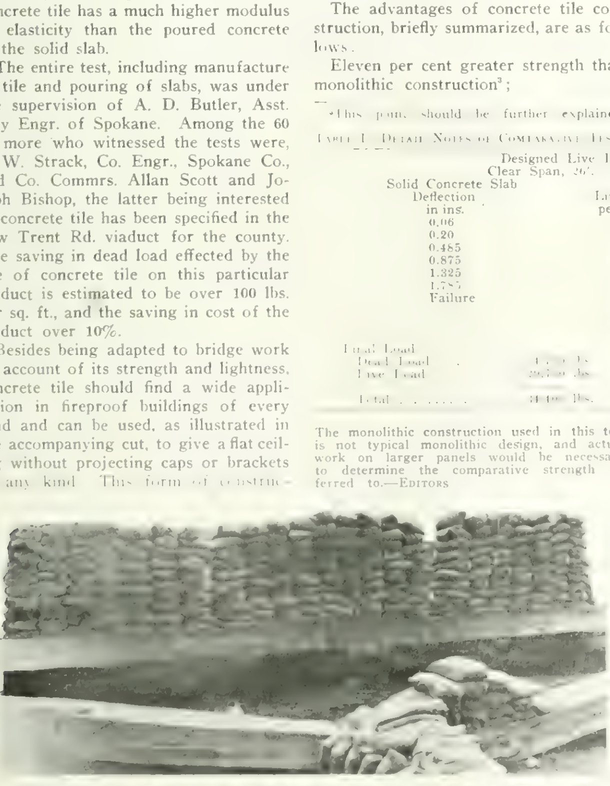
Designed Live Load, 75 lbs. per sq. ft.
Clear Span, 26'. Age of Concrete, 30 das.

Solid Concrete Slab Deflection in ins.	Live Load per sq. ft.	Concrete Tile Slab Deflection in ins.
0.06	75	0.075
0.20	150	0.265
0.485	225	0.475
0.875	300	0.75
1.325	375	1.01
1.785	450	1.325
Failure	508	1.60
	525	1.74
	546	2.30
	563	Failure

Solid Concrete Slab		Concrete Tile Slab	
Final Load		Final Load:	
Dead Load	[illegible] lbs.	Dead Load	5,400 lbs.
Live Load	[illegible] lbs.	Live Load	32,875 lbs.
Total	[illegible] lbs.	Total	38,275 lbs.

The monolithic construction used in this test is not typical monolithic design, and actual work on larger panels would be necessary to determine the comparative strength referred to.—EDITORS

Concrete tile slab sustained 7½ times the designed live load, and 11% more than the solid slab.



[illegible]

Many engineers, architects and draftsmen have a business card or form on a rubber stamp, but have found it difficult to use it satisfactorily for purposes of reproduction on blueprints. J. W. Lawrence, of the Colorado Agricultural College, Fort Collins, Colo., states that the following method works successfully. The impression of the stamp is made upon the linen with an ordinary rubber stamp ink and while the ink is still moist it is dusted over with lampblack, soot, some other form of powdered carbon or any pigment in powder form which is actinically impenetrable and the impression comes out clear and white on the blueprint.

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[3] This point should be further explained.

Sand Tests Essential to Good Work[*]

BY W. B. REINKE

"Watch your sand" might well be selected as the slogan of the message presented in the following paper. The quality of the sand used in concrete is too often overlooked. Mr. Reinke points out some of the possible dangers from such carelessness

For any proposed piece of concrete construction, engineers as a rule, and rightly so, are very willing to inspect or have inspected the cement to be used, accepting as a matter of course the necessary expenses involved.

When the subject of sand testing is brought up, however, the reply is generally, "Oh! we don't care about that," or "We will have samples sent to this office and look at them to determine their value." As a rule, they are quite satisfied that they have taken care of everything needed to produce a good concrete when they write strict specifications for the cement. They "pat themselves on the back," look pleased and forget about the sand, overlooking the fact that this material is used as found in its natural state with every chance for wide variation in quality and that it forms from two to four times as much of the concrete as does the cement.

Sand Specifications Indefinite

Few specifications contain definite requirements as to the quality of sand, the subject being dismissed with a general clause, providing that it must be clean, sharp and free from loam. As generally interpreted, the word loam includes clay matter and finely divided silica. Experience has shown that for the best results in work, sand may be too clean, that it need not necessarily be sharp, and that under some conditions a certain amount of clay or finely divided silica is advantageous. The quality of sand is judged, as a rule, by the eye and touch. No attention is paid as to what the mineral constituents composing it may be; what granulometric analysis it may have; whether it may or may not contain minerals in a combined or a free state, which will make it harmful to the concrete; whether it is so finely divided as, through the formation of colloids or otherwise, to retard or inhibit hardening of the concrete; or whether it may contain soluble alkalies, which may hasten the set of the cement to such an extent that the initial set is broken while it is still in the mixer and the whole mass becomes for a period, so far as setting is concerned, so much inert or at best feebly cementitious material.

Testing Practice Not Uniform

While the testing of sand is becoming more general, the work is being done under more or less tentative specifications prepared by individuals; no two laboratories seem to apply the same tests or use identical methods, the tests being carried out differently by each investigator. Most tests are made on samples delivered to the laboratories, no opportunity being allowed for the examination of the deposit or the selection of truly representative samples. The reason for this is chiefly one of dollars and cents, and since the condition obtains, the laboratory must do the best it can with the sample submitted.

The following are the usual tests to which samples of sand submitted for testing are subjected, but it is rarely that all are employed in any one laboratory:

1. Determination of the percentage of moisture;
2. Determination of the percentage of voids;
3. Granulometric analysis;
4. Determination of the percentage of silt;
5. Chemical analysis to determine silica and content of clay matter;
6. Loss on ignition;
7. Volume of mortar from a given amount of sand and cement;
8. Comparative tension tests of mortars made from work sand and standard Ottawa sand, using identical cement and only sufficient water to produce normal consistency.

Compression Tests Better

At this point it is hardly necessary to call attention to the fact that although tension tests are used for testing sands, this practice would seem to be altogether arbitrary and has grown out of the long-established custom of making tension tests of cement, which, as every one knows, was instituted only on account of convenience of having small portable inexpensive machines, which could be carried from one place to another without much trouble.

We would suggest that all comparative sand tests be made on cubes or cylinders subjected to compression, as concrete itself is rarely subjected to tension. This practice has been adopted in Germany, where tension tests of cement and sand mortars have been largely eliminated.

To the foregoing tests should be added several not usually carried out:

1. Microscopic examinations, which need not necessarily be exhaustive;

Table I—Showing Loss in Tensile Strength for Each Percentage of Water Required to be Added to Mortar

Normal Consistency

Period	Ottawa Sand			Work Sands.																	
	9.2 per cent Water, 100 Tests			12 per cent Water, 18 Tests			12–13 per cent Water, 30 Tests			13–14 per cent Water, 16 Tests			14–15 per cent Water, 12 Tests.			15–16 per cent Water, 8 Tests.			Over 16 per cent Water, 16 Tests.		
	Max.	Min.	Av	Max	Min.	Av	Max	Min	Av	Max	Min	Av	Max	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.
72 hours	245	160	192	278	110	200	168	62	105	150	57	80	80	48	52	58	40	43	48	40	43
7 days.......,.......	384	233	301	420	180	273	288	176	258	340	97	215	265	99	170	262	89	158	240	73	129
28 days	502	300	410	605	270	388	462	277	377	493	465	325	455	133	262	321	183	251	340	129	187

Work Consistency

Period	Ottawa Sand.			Work Sands.																					
	13.8 per cent Water, 64 Tests.			17–18 per cent Water, 8 Tests.			18–19 per cent Water, 6 Tests.			19–20 per cent Water, 12 Tests.			20–21 per cent Water, 10 Tests.			21–22 per cent • Water, 8 Tests.			22–23 per cent Water, 6 Tests.			Over 23 per cent Water, 10 Tests.		
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max	Min.	Av.
72 hours	190	100	140	115	80	92	92	80	86	67	58	63	63	52	55	50	18	30	30	12	23	31	10	18
7 days	280	178	235	236	170	208	210	140	180	187	107	146	150	110	128	158	100	122	125	95	111	120	58	92
28 days	374	230	316	371	292	310	300	239	279	342	186	267	270	180	229	261	183	220	250	175	215	202	143	173

(Reinke I)

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[*] A paper presented before the 16th Annual Meeting of the Am. Soc. for Test. Mat.

TABLE II.—SHOWING LOSS IN TENSILE STRENGTH FOR INCREASED PERCENTAGE OF SAND PASSING NO. 40 SIEVE

NORMAL CONSISTENCY.

Period.	Ottawa Sand, 100 Tests.			Work Sands.														
				Up to 10 per cent, 10 Tests.			10–20 per cent, 15 Tests.			20–30 per cent, 15 Tests.			30–40 per cent, 16 Tests.			Over 40 per cent, 28 tests.		
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.
72 hours	245	160	192	260	143	190	190	125	152	135	90	125	170	44	83	110	40	61
7 days	384	233	301	420	222	340	343	225	270	262	110	222	288	100	200	265	90	170
28 days	502	300	410	605	380	438	431	296	365	403	187	344	462	178	311	376	133	271

WORK CONSISTENCY.

Period.	64 Tests.			10 Tests.			11 Tests.			11 Tests.			10 Tests.			22 Tests.		
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.
72 hours	190	100	140	112	22	81	115	25	77	100	10	55	84	22	55	85	10	28
7 days	280	178	235	230	172	188	236	97	170	176	33	130	194	84	128	213	46	106
28 days	374	230	316	352	269	313	371	160	263	274	170	232	367	130	221	304	97	191

(Reinke II)

2. The effect on strength developed by the use of different cements;
3. Permeability of resulting mortars;
4. Weight per cu. ft. as received and dried;
5. Determination of the amount of organic matter contained;
6. Tension or preferably compression tests on wet mortars, having the same consistency as used in the work.

This last test the writer believes to be the most important, and one to which all sands should be subjected. To the best of our knowledge, however, it is not generally used by laboratories other than the one with which the writer is connected.

The general practice in testing sands is to compare work sand with standard Ottawa sand, using the same cement, the briquettes being made from mortars having normal consistency, that is, the consistency of a 1:3 Ottawa sand mortar when made according to the standard methods for testing cement. In the test just referred to the sand is made into a mortar of work consistency, that is, the consistency required in mortar to permit the concrete to be poured.

The practice of making comparative sand tests using wet mixtures was developed in our laboratory some years ago while we were trying to find the reason why a sand known to have caused trouble in a certain piece of concrete work gave, when mixed into mortar of normal consistency, tensile strengths greater than those obtained from the same cement and Ottawa sand.

Details of Procedure

The method of procedure in our laboratory is as follows: The sand to be tested and Ottawa sand are first made into mortars of normal consistency, using preferably cement from the work. These mortars are then made into briquettes, the whole operation being in accordance with the prescribed methods of the Am. Soc. for Test. Mat. for making sand briquettes when testing cement. The amount of water necessary to make a mortar of normal consistency having been found, a new batch of sand and cement in the desired proportions is thoroughly mixed dry and placed in a cylinder that can be revolved, together with a number of flint pebbles, so that the proportion of the cement, sand and stone will approximate that desired in the actual work. To this mix is added enough water (generally about 50% more than needed for normal consistency) to make a mortar having work consistency. The cylinder is then closed and revolved for 5 min. The flint pebbles are picked out by hand and the mortar is made into briquettes. This test more closely approximates the conditions found in actual work, and the strengths obtained from briquettes made from such a mortar, though, as a rule, far below those obtained from a mortar of normal consistency, correspond to those that may be reasonably expected from the mortar if the sand and same cement are used in construction.

It is to be noted that in most cases, using the same cement, more water will be needed to bring a natural sand to normal consistency than is necessary with Ottawa sand. The difference in the amount of water required is accounted for by the difference in granulometric grading, the work sand, as a rule, having the greater amount of fine material, and hence more surface to be covered and a larger percentage of voids.

Relation of Consistency to Strength

Further, it is to be noted that the strengths obtained from a natural sand when made into a mortar of normal consistency are often equal to or greater than those obtained with the same cement, using Ottawa sand. When the same natural sand and cement are made into a mortar of work consistency, which requires about 1½ times as much water as for normal consistency, the reduction of strength will be more or less marked, depending on the character of the natural sand. The strength of all sand mortars is affected by the amount of water used over that required for normal consistency. The more water used, the greater will be the loss in strength at early periods. The nearer a natural sand approaches the ideal in physical and chemical composition, the less will be the loss in strength for each additional per cent of water added. The amount of water required to bring a given sand to work consistency forms one of the best measures of the quality of sand.

In mixtures using 50% more water than required to produce normal consistency, Ottawa sand and good natural sands lose from 25% to 35% of their strength up to the 28-da. period, while a poor sand may lose as much as 70% or 80% of the strength developed when made into mortars of normal consistency. It has been found by experience

TABLE III.—SHOWING LOSS IN TENSILE STRENGTH AS SILICA CONTENT IS DECREASED

NORMAL CONSISTENCY.

Period.	Ottawa Sand.			Natural Work Sands, with Silica Content of														
				Over 95 per cent.			90–95 per cent.			85–90 per cent.			80–85 per cent.			Less than 80 per cent.		
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.
72 hours	245	160	192	200	165	187	185	90	160	168	80	136	165	40	80	56	44	41
7 days	384	233	301	414	280	330	379	160	272	290	97	232	317	90	211	276	130	213
28 days	502	300	410	568	435	487	605	256	398	462	165	360	414	195	326	415	190	298

WORK CONSISTENCY

Period.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.
72 hours	190	100	140	108	64	89	100	36	64	115	45	57	84	10	43	36	15	21
7 days	280	178	235	229	103	187	236	83	160	192	101	147	220	47	133	210	33	132
28 days	374	230	316	371	203	304	370	148	275	316	222	262	326	173	237	312	143	235

(Reinke III)

that with two sands, other things being equal, the one having the smaller amount of fine material will have the less amount of surface to be covered and when mixed with a given amount of cement will need less water to produce a definite consistency than the one containing a larger proportion of fine material.

Many engineers maintain that in making comparative tests of sand, the same amount of water should be used with each sand, overlooking the fact that in actual work one sand will require more water than another to bring the mortar to the consistency required by the work. We cannot assume that the same percentage of water will give the same consistency with two different sands. If this practice is followed one sand may have too much water and the other too little. In the actual work where the sand is to be used, a concrete of a certain consistency will be made with no regard to how much water is needed to obtain it, and in order that the test give a correct indication of the strength the sand will develop under actual work conditions, the test mortars should be made of a corresponding consistency. As stated before, most natural sands take about 1½ times as much water to produce work consistency as is required for normal consistency. This, however, is not true of Ottawa sand which, while taking less water to produce normal consistency, requires more than 50% addition to produce a mortar of work consistency.

Summary

In general, it may be assumed:

1. That the less water required to produce a mortar of a given consistency, the higher will be the strength developed by the sand.
2. That the coarser the sand, other things being equal, the greater will be the strength developed.
3. That the higher the silica content, other things being equal, the greater will be the strength developed.
4. That where it is necessary to use sands of poor quality, loss in strength at early periods can be largely overcome by using a dry concrete.
5. That the loss of strength is confined chiefly to short periods, being practically overcome with time.

The results of the tests recorded in Tables I to III will help to make these points more clear. They are the averages of tests made within the past year, made up with various cements. It wlil be noted that while the averages conform to the general rules above given, the maximum and minimum results given show variations. This is due to the fact that other conditions may overcome, to some extent, the particular effect the results are intended to illustrate.

The Concrete-Steel Engrg. Co. has recently been engaged as consulting engineer by the Water Board of the city of Watertown, N. Y., in connection with designing the new concrete arch [illegible]

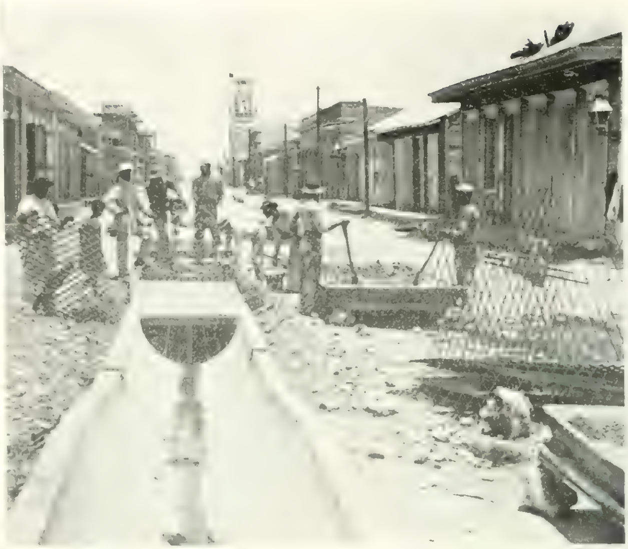

Fig. 1. Detail View Showing Construction of [illegible] Sewer in San P. De Macoris

Sewer Construction in San Domingo

In the June, 1913, issue under Consultation Item 313, the comparative efficiency of monolithic conduit and large concrete pipe was discussed. The specifications suggested in the question were that a wooden form either with flat or rounding bottom, should be built by which the invert should be formed. It was further suggested that when the concrete was sufficiently set a flat cover of concrete should be placed over the half-round invert by pouring it on a light timber centering. This question came from the Pacific Northwest and was discussed by Chas. E. Sims, Worthington, Minn.

As if in answer to this question although there has really been no exchange of correspondence, Octavio A. Acevedo, a constructing engineer at San P. De Macoris, Dominican Republic, West Indies, sent in the accompanying illustration and notes. Fig. I shows the first storm sewer built in San P. De Macoris in 1912.

As indicated by the illustration, an invert is first cast and finished smoothly and accurately to grade. This is then covered by a flat reinforced concrete deck poured on light forms as shown. The sewer illustrated is 560′ long. There are three sections with horizontal diameters of 26″, 42″ and 48″. The concrete work in the invert is mixed 1:3:5; for the cover 1:2:4. A heavy No. 10 expanded metal is used to reinforce the cover.

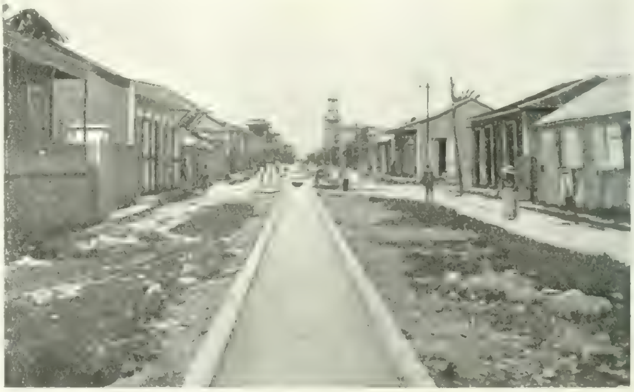

Fig. 2. [illegible] Sewer in San P. De Macoris

Simple Form for Column Footings

BY STERLING H. BUNNELL*

Barn door hinges and hasps are used successfully to hold forms for concrete foundations in place. Accurate and economical work is obtained by simple methods.

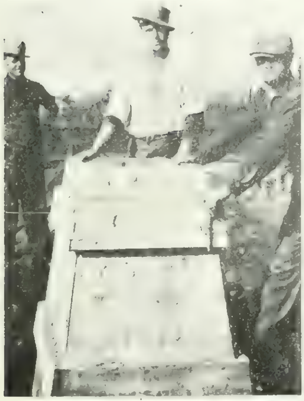

Fig. 1—A Form For Foundations In Place
The forms are hinged and held in place with a hasp and pin

The new boiler shop of the Griscom-Russell Co., at Massillon, O., is formed with steel columns sustaining fenestra glass walls, and supported on concrete piers. The ground was hard, firm clay, at a level 3′ below the future floor of the shop, requiring little excavation for the footings. The piers were accordingly concrete pyramids standing about 5 ft. high, mostly above ground. Each pier was formed with a groove 6″ wide on each side, in and between which concrete foundation walls were afterward poured. The piers were constructed by the use of a convenient and clear wooden form designed by Robert J. Pabodie, works manager of the company.

The four illustrations show the method of constructing the foundations of the shop. Fig. 1 shows the form or mold in position for pouring a footing. The left face of the mold is hinged to the two sides; the opposite face (to the right in the illustration) is loose, and is held in position by hasps, staples and wooden pins. After the pier has been poured and has set, the loose side can be detached by pulling out the pins from the hasp staples and throwing back the hasps. Fig. 2 shows the mold being removed from the pier. In this figure the white streak on the left face of the concrete is the wooden key which formed the slot for later securing the edge of the wall which is to extend from pier to pier. These keys were beveled enough to provide for easy removal without cracking the cement, even though the concrete was allowed hardly time to set before removing the form.

Fig. 3 shows part of the western line of the building, with a number of completed piers, and the parts of the mold in the distance. The slots in the columns, to secure the future foundation wall, are plainly visible.

All the piers and connecting walls of the building were completed, and all foundations for future machines, testing tanks and pipe trenches were put in complete, extending slightly below the original ground surface, before any filling was done. When all the concrete was completed and well set, the remaining space was filled with burnt sand and waste from the foundry, so as to bring the floor level to the top of the piers, and even with the floor of the existing machine shop and foundry. The entire work was done by laborers, under the direction of one competent engineer with tape and level. When finished, bolts which were set in each pier, for holding the steel columns, tested out within [illegible] of perfect alinement on the entire length of the building.

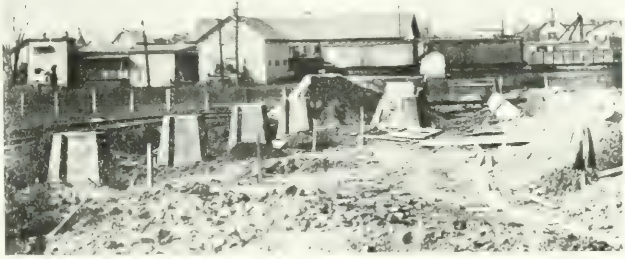

Fig. 3—General View of the West [illegible] Showing Completed Foundations

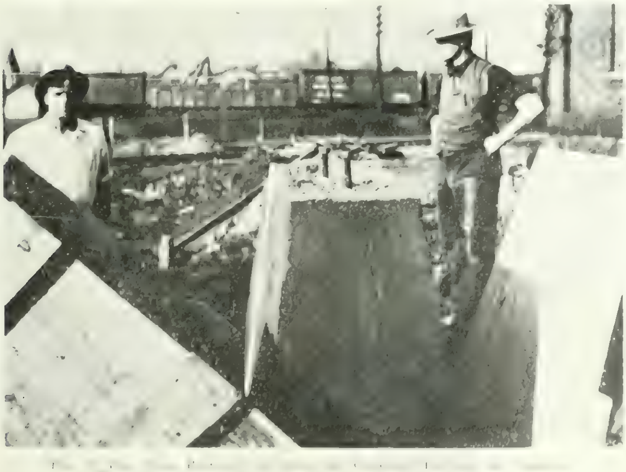

Fig. 2—The Form Removed [illegible]
[illegible]

It has been decided to build the new dyehouse for Stephens Sanford & Sons, Inc., Amsterdam, N. Y., almost wholly of reinforced concrete. Charles T. Main, engineer, Boston, is executing the engineering work for this building, including the equipment. The dyehouse will be 257′ long, 108′ wide at one end and 55′ wide at the other end, five stories high and will contain approximately [illegible] sq. ft. of floor space.

The MacArthur Concrete Pile & Foundation Co., N. Y. C., has been awarded the contract for the foundation of the new 2,000,000-cu. ft. gas holder for the Mohawk Gas Co., Schenectady, N. Y. [illegible] concrete piles are to be driven. The Bartlett Hayward Co. is the contractor.

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*Eng., The Griscom-Russell Co., N. Y. C.

Steel Sheet Piling as Concrete Centering

An automatic electric pumping station has recently been built by the Eon Engrg. & Contrg. Co., Brooklyn, N. Y., on the corner of Rue de St. Felix and South St., Far Rockaway, L. I., to raise the sewage to a height that will permit it to flow into the Atlantic ovean. The station was constructed about 1,000 ft. from the water edge in white sand which is thoroughly saturated with water below a depth of 4′ to 5′.

The station is circular in form with a partition wall dividing it into two separate chambers, one used as a basin for reception of sewage, and the other to contain the pumps. The station is 27′ outside diameter, the outside walls and the roof being made of reinforced concrete 15″ thick. The reinforced concrete floor is 24″ thick and the partition wall 12″.

The structure rests on timber piles cut off at a depth of 18′ below street level, the tops of the piles being embedded in the concrete. In the pump chamber are two motor-driven centrifugal pumps, with 7-in. suction and 6-in. discharge pipes. They are controlled by two floats located in the sewage chamber, and operate to lift the sewage to a height of approximately 8′, thereby causing it to flow through the discharge pipe into the ocean.

The job would have been extremely difficult if it had not been for the strength and watertight interlock of the sheet piling[1] used as shown in the accompanying illustrations. The sheet piling was set up in a circle about 27′ in diameter as shown in Fig. 1. The concrete was placed against the sheeting with a layer of thin tar paper used to prevent the concrete from binding against the steel. The tar paper may be seen protruding slightly above the concrete already in place, as shown in Fig. 2. This feature proved entirely satisfactory as no difficulty was experienced in drawing the sheet piling.

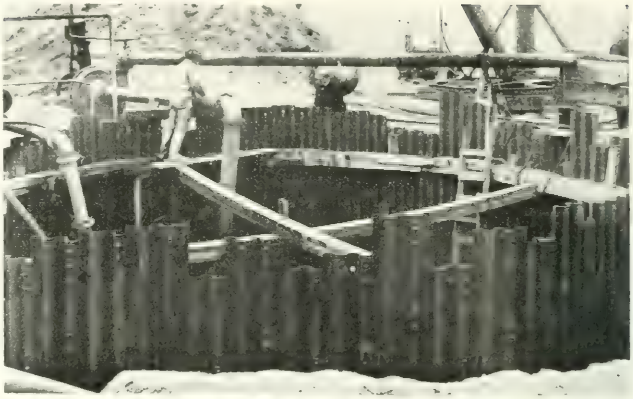

Fig. 1—General View of Exterior of Sewage Pumping Station Under Construction

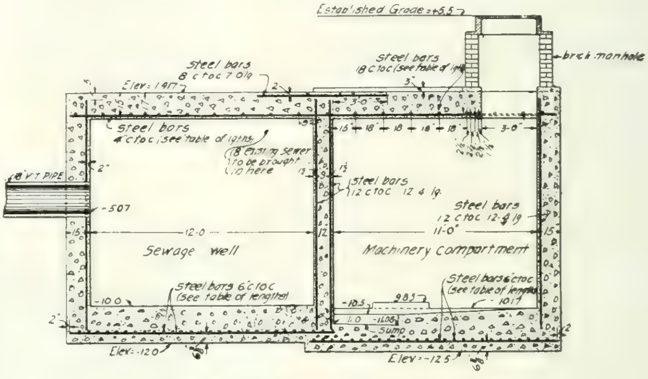
Established Grade = +5.5
steel bars 8 c to c 7 0 lg
steel bars 18 c to c (see table of lgths)
brick manhole
Elev = 19.17
2
3″
3-0″
15
17
steel bars 4″ c to c (see table of lgths)
18 existing sewer to be brought in here
15 18 18 18 18
3-0″
2″
18″ V.T. PIPE
13
1½
steel bars 12 c to c 12 4 lg
steel bars 12 c to c 12-4 lg
-5.07
15
12-0
12
11-0″
15
Sewage well
Machinery compartment
steel bars 6″ c to c (see table of lengths)
Steel bars 6″ c to c (see table of lengths)
-10.0
-10.5
9.85
-10.17
2″
1.0
-11.08
sump
2
Elev = -12.0
Elev = -12.5

Fig. 3—Detail Section of Sewage Pumping Station

The curved interlock of this type of sheet piling made it very desirable for the job as the ordinary straight sections could be set in a circular formation without in any way impairing the strength and tightness of the interlock. The piling used was in 24-ft. lengths with short locking clips. It was driven to a depth of approximately 4 ft. below the bottom of the excavation, in order to insure a strong toe-hold, and make bracing unnecessary in the bottom of the pit where it would interfere with the construction of the foundations.

The piling was driven at a low cost with the aid of a water jet, at a pressure of about 100 lbs. through a 2-in. pipe reduced at the nozzle to ¾″. The method of operation was to work the jet back and forth in the direction of the line of sheet piling, until the pipe had reached the depth to which the piling had to be placed. Without stopping the flow and with the jet pipe still in the hole, the pile was dropped in place. Then the jet was withdrawn and the previous operation repeated. Thus each 24-ft. sheet

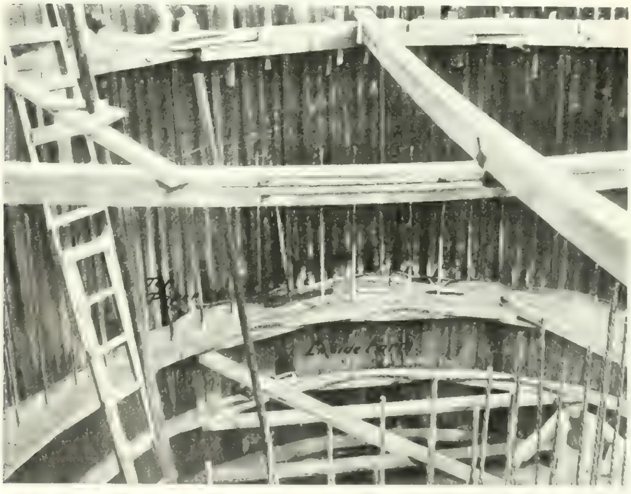

Fig. 2—A Detailed View of the Interior of Pumping Station Construction Showing the Use of Steel Sheet Piling Lined With Tar Paper for Concrete Exterior Forms

pile was placed in about 4 min.

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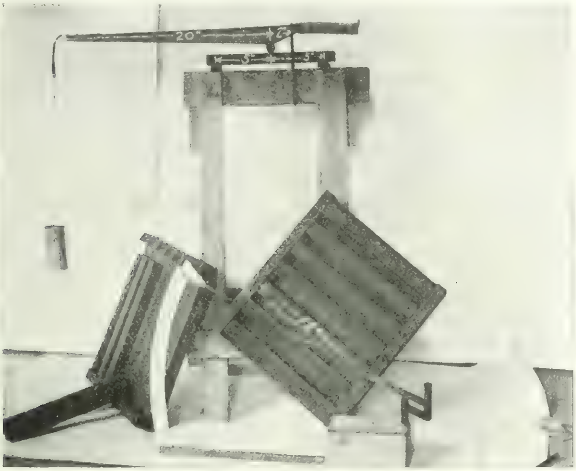
[1] Wemlinger Steel Piling Co., N. Y. C.

The piling was later pulled by means of a stiff leg derrick operated by a steam hoisting engine. No special equipment was used for the purpose, and although, as stated before, there was no space left between the concrete and the piling, no difficulty was experienced in pulling. As a matter of fact, the piling was in such excellent condition that the contractors, having no further immediate use for piling of this length, disposed of it to another contractor at a very good salvage value.

A Simple Apparatus for Testing Cement Prisms.

By H. C. Johnson*

[In the May, 1913, issue, page 257, was published an abstract of a paper by Mr. Johnson on the strength of cement. In his investigations, Mr. Johnson used prisms in flexure as an indication of strength, and the following notes describe in detail the way in which the prisms were made and the equipment for breaking them.—Editors.]



Detail View Showing Molds and Equipment for Making and Testing Cement and Cement Mortar Prisms

This apparatus is so simple that any builder, using cement for ordinary building work, could have it made up in a very short time. The main point to keep in mind is that for the molds, a hard wood should be used, because the cement and water would soon "rag" out white pine or any other soft wood.

The Teak Wood Molds

The molds here shown are of teak, the 1 in. sq. bars being placed 1" apart to form 6 prisms 1" sq. in cross-section, the length being 12". They are tested, however, on a span of 10". The end pieces, holding the teak separating bars, are notched to receive them and screwed to the base piece which is also of teak, 14" x 14".

The Bending Equipment

As will be seen, the breaking machine is composed of a simple carpenter's horse or trestle, two supports, a lever and a small pail. The trestle has two shallow grooves cut in the top with their centers exactly 10" apart. In these are placed pieces of teak, one square on the under side, the other rounded so that it may adjust itself to an irregular test specimen, and both rounded on the top, side in *both directions,* so forming a "one point" contact with the specimen.

Two inches to one side of the center is fixed a yoke-shaped piece of ¼-in. wire to form a fulcrum for the lever which is balanced on a hardwood roller resting on the test specimen.

The outstanding arm of the lever, to the end of which is hung a small pail for shot, has a length of 20"; thus a leverage of 10 to 1 is obtained.

It will be noticed that on the side of the fulcrum opposite to the lever but an extension of it, is fixed a piece of lead pipe slipped over a length of ¼-in. wire attached to the lever end. This acts as a balance for the outstanding part of the lever and the empty pail, and, if properly adjusted, will cause the lever to be horizontal when the whole is placed on the roller, the fulcrum being temporarily removed to allow this adjustment.

The total load carried by the specimen will then be: 10 times the weight of shot in the pail, plus the weight of the lever and pail and its counterweight.

General Operation

Neat cement prisms were made up by the writer which carried all the way from 40 lbs. to 100 lbs. at 7 days, but in future only mortar specimens will be made since it is the adhesive power of the cement that is required, not the cohesive power, or in other words, the binding value of a cement.

For his own comparative tests a man need not purchase standard sand; the sand usually used, either washed or unwashed (as used on the job), is quite the thing, in fact even to be preferred, since a cement that shows up poorly in standard sand compared with another cement, may be better in the local sand.

It must, however, be borne in mind that to obtain a true comparative test the following points must be observed:

1. The same sand (washed or unwashed as used on the job) must always be used.
2. The proportions (usually 1:3) of sand to cement must be the same in all cases.
3. The same room and water temperature—about 60° to 70°.
4. Approximately the same percentage of water (by weight of dry materials), usually from 8½% to 10%, should be used.
5. Specimens of the same age only can be compared.

Water-cured specimens are to be preferred, and if a true cement is to be found both air- and water-cured specimens could be made—those showing up much better when air-cured than when water-cured should be looked on with suspicion.

For reinforced concrete and other very important work, where a cement will have to do its duty, this test is not sufficient; samples should then be submitted to a recognized testing station.

The Use of Lamp Black in Concrete

The question has been recently raised as to whether or not the use of lamp black in concrete surfacing mixtures weakens the concrete at all. No tests seem to have been made to determine this because no one seems to have seriously supposed that lamp black would weaken the concrete when used in the very small proportion necessary to accomplish the desired result in coloring the surface.

Pure lampblack is pure carbon, which combines very homogeneously with the concrete, and as the quantity used to color pavements is only about 1 lb. to 2 lbs. of lampblack to each barrel of cement, it is hardly probable that lampblack, an entirely inert material, would effect in any way the strength of the concrete.

Some prejudice is probably stirred up against the use of concrete in pavement and sidewalk work due to the glare of the white or grayish surface, and it might be well to eliminate the possibilities of these objections by a broader use of coloring materials such as lampblack.

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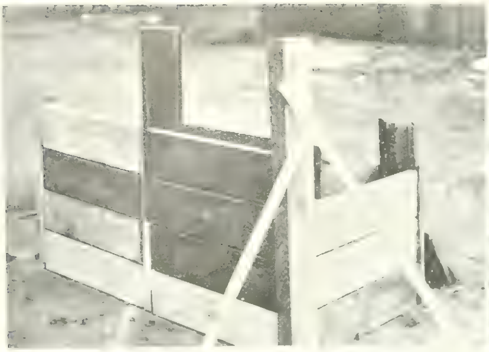
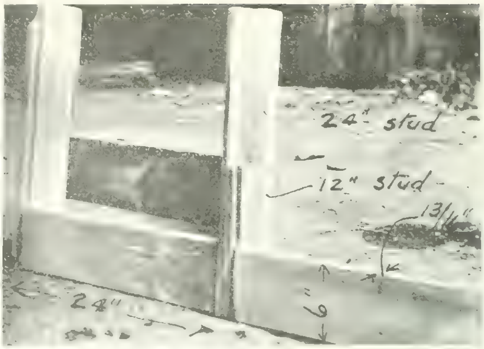


[illegible] Wall [illegible]



[illegible] sections.

"Featherweight" Concrete Units for Wall Construction

Masonry construction has always seemed to imply the handling of heavy units. Brick, laid by hand in mortar, has probably been heretofore the smallest form of unit masonry construction, and concrete block, either single or double, have always offered a most efficient masonry unit, for while it is, compared to brick, a heavy unit, yet placed at one operation, it is the equivalent, on the average, of about 15 brick, and in this way makes for efficiency and economy.

Considering the problems of wall construction with relation to unit construction only, without considering the many developments in poured concrete walls, and the forms therefore, we find that the endeavor has been to secure not only a unit with the least weight per super. ft., but to develop a unit, and methods of placing it, which would offer the maximum economy.

At one extreme in this development we have a house unit which is cast in large sections, a half the size of a room at a time, and swung into place with a traveling crane. The latest and probably one of the most efficient developments in the opposite direction is the unit system described in the following notes, and which is the invention of F. McM. Sawyer, an architect of Los Angeles, and controlled by the American Roofing Tile Co., of Charlotte, N. C.

Essential Features

Sectional interlocking self-aligning concrete lumber seems to be about the best way to describe this system. The wall unit is really concrete sheathing, 13/16" thick, with bevel sides and tongue ends, flush on the rear face. The sheathing for the inside and outside walls are identical. The unit described in these notes is of the standard thickness and 6" wide by 22½" long, weighing 8 lbs. The methods of casting the units are so flexible, however, that units of any size could be easily cast.

The studs are formed by using two concave concrete sections placed face to face, with the interior poured with concrete, as the work proceeds. The general arrangement is shown in the accompanying illustrations. The tongue of the slab is held in place in a groove at the side of the concave stud sections. This is shown plainly in the end view of the molds for the column section. (Figs. 2 and 6).

Probably the most interesting feature in the use of this double stud is the staggered section. The half studs are made in 6-in., 8-in., and 10-in. widths, and in a standard length of 24". A 6-in. concave section, 24" long weighs approximately 5 lbs. per lin. ft. To start a stud, however, a section 12" long is used, facing a 24-in. section as shown in Fig. 3. This produces in actual operation, what practically amounts to a self-aligning stud. In the early development of this system, Mr. Sawyer used one piece studs in full story lengths, which required that each slab had to be raised way to the top and slid down into place. This, of course, was very inefficient.

The sectional stud does away with this objection; the slabs hold the stud sections in place as they are put up, and the concrete poured in the cavity formed by the two concave sections, produces practically a solid concrete column. Reinforcing steel can be used if necessary, to reinforce these columns.

In this stud and sheathing construction, there is a cetrain distinct analogy to wood frame construction, in economy of materials, hollow walls, and ease and rapidity of construction. As the system offers, moreover, a light masonry unit, producing a permanent fireproof wall structure, there is a distinct analogy

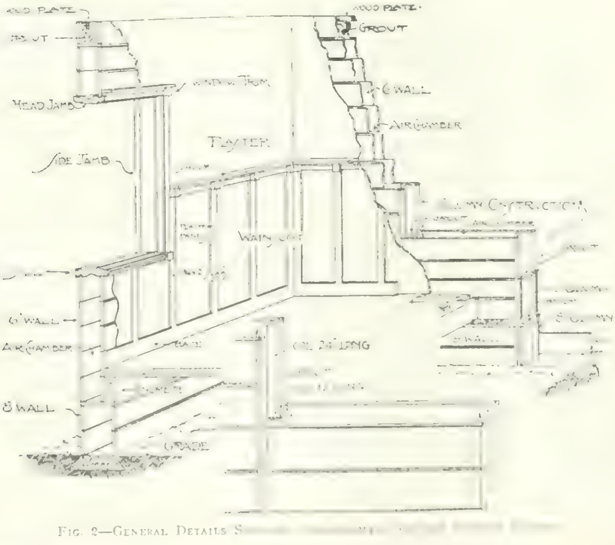


FIG. 2—GENERAL DETAILS S[illegible]

to cement or clay brick, or light concrete block construction.

Details of Finish

To finish the exterior, a coat of stucco is applied uniformly on the surface. This should be a very satisfactory finish, for the slabs and studs present such a uniform surface that the average thickness required is not more than 3/16" to ¼". This thin coating, knitting, as it sets, to the concrete of the slabs, forms a coating which should not crack, under any but extreme conditions. The coat of stucco, working into the V-shaped grooves produced by the bevel of the slabs, and into the vertical grooves of the stud sections, knits the wall together into a solid surface. The plaster of the interior acts in the same way.

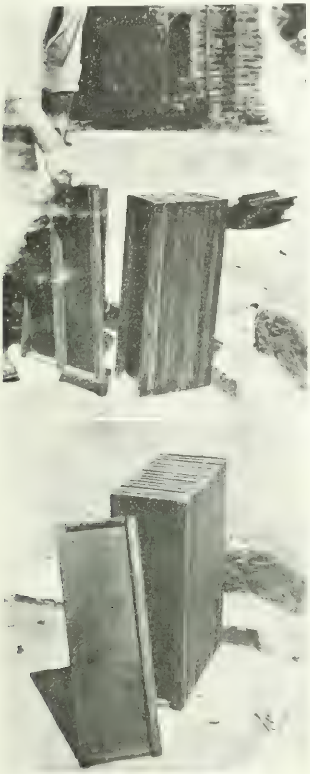
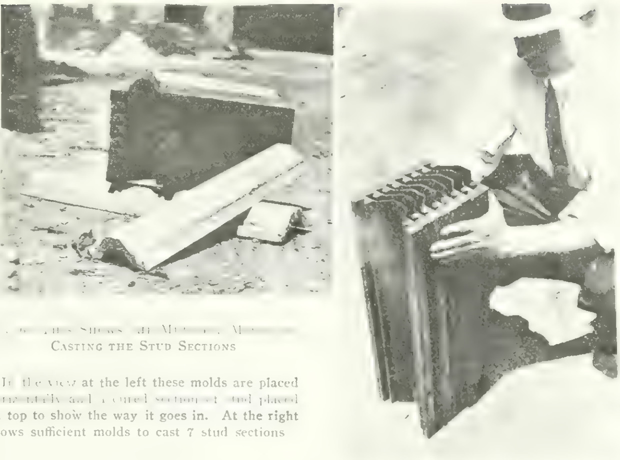


Fig. 4—[illegible] Making the Wall Panels

The upper picture shows [illegible] one man can handle the forms. Below is shown a little clearer the quarter-round sections at the end. This is detailed in Fig. 5. The molds nested together in the lower picture and the one leaning in front represent the molds for 15 units or 15 sq. ft. of wall centering

Casting the Units

The above paragraphs present a brief outline of the essential features of a wall construction, which requires the use of a great number of small units, accurately cast of good concrete. Before such a system is in any way practical, there must be available practical means of producing the required units and producing them at low cost. While the units and their erection might seem at first to be the most important phase of this development, a broader perspective would show that the process of casting a great number of units with wet concrete in multiple molds, is relatively more important. Such a process of casting affords a means for producing a unit of almost any dimensions, and with, apparently, a minimum of labor and equipment.



[illegible] Showing the Method [illegible]
Casting the Stud Sections

In the view at the left these molds are placed horizontally and a cured section of stud placed on top to show the way it goes in. At the right shows sufficient molds to cast 7 stud sections

The Multiple Molds

The accompanying illustration (Fig. 4) shows several of the molds for the wall slabs. These molds are simply a piece of 22 ga. black iron with a strip nailed down each side, and across the ends as shown in the sketch (Fig. 5). These partitions, as it were, are stacked together to form a series of multiple cells, each one of which is the mold for a concrete unit.

The illustration shows a few of the molds stacked up. In actual operation, many thousand molds are used. The level floor of the "foundry" is used as a pouring floor. The partitions are stacked vertically, and in accurate alignment and clamped tightly by a screw-jack or clamp arrangement. It is common practice to pour more than one row of cells at a time, as rows of molds can be stacked along side of one another without interference.

Pouring is done with a slush mixture, and equipment can be adapted to meet the particular condition of the plant. A tank with an agitator, carried on an overhead trolley has worked out very well in some plants.

Oiling Forms

The forms are at first dipped in oil to prevent the concrete sticking to them, and are dipped in oil between every few pourings. The black sheet iron seems to "cure" or become apparently so impregnated with oil that the concrete does not stick at all. This could probably be accounted for by the fact that a film of hard oil forms on the surface so that a very little more oil applied seems to do the work.

After the forms are filled, they are allowed to stand from 24 hrs. to 48 hrs. The clamps are then loosened, and the molds are laid back, and the green segments lifted out and stacked to cure. The mixture is of such richness and consistency that the product can be handled very early with little danger of breakage.

Erection Details

As usual in block or brick masonry, the start is made, after the footings are in, at a corner. With the batter boards and the lines, a couple of heavy boards, nailed edge to side to form an angle, are erected, braced and plumbed, so that

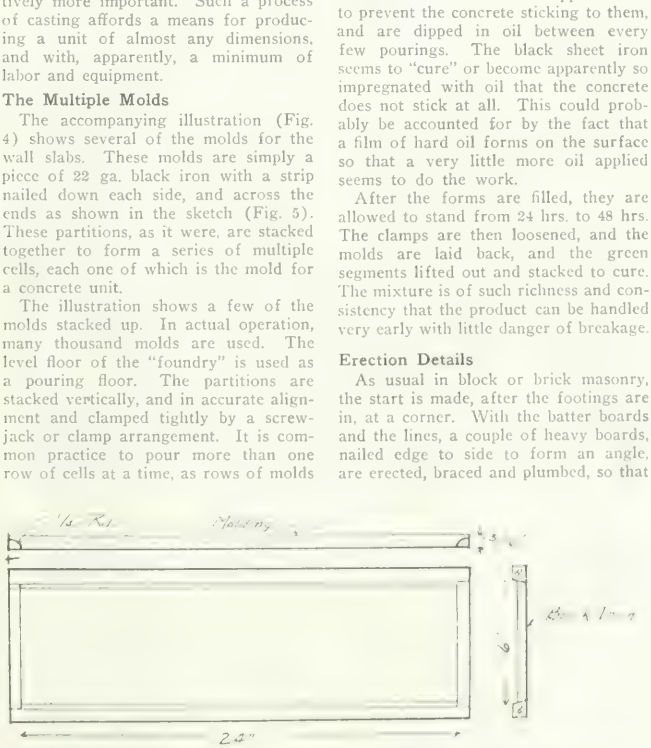


Fig. 5—Sketch Showing [illegible] Measurements [illegible] Casting the Wall Units

the interior of the angle is the corner of the wall. A slab is then laid on edge on the foundation and against the inside of the frame and another one to face it. Against this a stud section, either 12-in. or 24-in. is placed, lined and plumbed, faced with another stud section, the slabs extended farther, the hollow opening in the stud filled, and the wall is started. To finish the corner, the slabs at the interior corner are braced with a vertical temporary wooden timber, boards, either concrete or lumber, are placed vertically between the slabs, and the corner poured solid.

A wall by this system can be erected easily and rapidly and presumably economically. In the upper left hand corner of Fig. 2 is shown the way in which the floors and roof are carried. A concrete slab is laid horizontally in the wall to produce the bottom board of a concrete beam, which can be poured in place and reinforced as required.

Window Trim and Interior Finish

Frames for the windows and doors are easily and accurately cast in multiple molds, and placed as the wall is erected. These frame sections are made to any required detail. For swinging the windows, which are usually of the casement type, slots are left at the hinge points in one of the frame-sections. When the wall is being erected, the sides of the frames are placed and the hinges are inserted; grout or mortar is then placed so as to back up the frame and embed the hinge tightly. The window is set by simply inserting the sash and attaching the hinge to it.

Wall Paper Finish

To finish the interior, a detail used on some of the houses built so far, consists of running a simple molding with Plaster of Paris or quick setting Keene cement. Over this is pasted or glued a wall paper printed to resemble very closely wood graining. A coat or two of varnish over this produces a finish which can hardly be told from wood. It is absolutely solid and yet has not the cold stone surface. Mr. Sawyer states that in his office in Los Angeles he has used wall paper very successfully as a floor covering, following the same detail, but using two or three coats of good quality of floor varnish.

General Notes

Partitions are made as easily as the outside walls. It is not necessary in a good many cases to make a double wall, and a stud section can be cast with one slot only, centrally located so as to make necessary the use of only one course of slabs.

It is interesting to note in detail that for walls up to grade an 8" or 10" column stud can be used. These are offset below the floor levels very easily by pouring a solid lintel upon which the floor can be carried.

Another interesting detail is the use of a wide column stud with three slots so as to make possible the use of three wall slabs. This gives a narrow hollow wall at the outer surface which can be filled in solid when required to produce better insulation, waterproofing or more bearing.

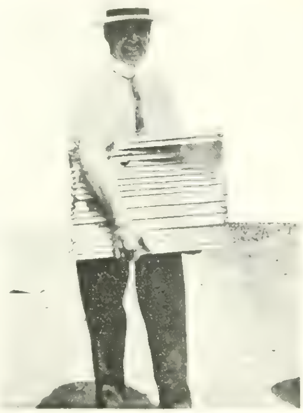


FIG. 7—THIS SHOWS ONE MAN HOLDING ENOUGH CONCRETE LUMBER TO PRODUCE 20 SQ. FT. OF WALL, ONE SIDE ONLY

This consists of 20 units, 6" x 22½" x 13/16", weighing 8 lbs. a piece.

These light slabs are, of course, unreinforced and are easily cut to size. This is done by putting a slab over a sharp edge and breaking it with a trowel by a quick blow. However any dimension wall can be erected as slabs are made of such standard lengths as to work in multiple of 6". One wall can be joined to another at any point to make a partition by simply setting up one of the half-sections of the stud against the wall and grouting in. By using a wet grout or mortar enough suction is produced in the set to hold the stud section in place. A similar detail is used to back window frames and door frames—that is, a half-stud section is grouted in place with its back to the frame.

All the units are so adaptable and flexible and the methods of casting them are so efficient that it seems as though this is a unit system which should meet with wide spread and satisfactory use.

Wet Concrete

The last few years have seen an extensive development in the methods of handling concrete by gravity in chutes. With this development, however, there seems to be more or less of a tendency to use mixtures which are "drowned." This practice is due to a large extent to ignorance of the laws governing the flow of concrete in chutes, and the ordinary contractor assumes that the wetter the mixture the better the flow, which is in reality not the case.

As a matter of fact, the flow of concrete in chutes is half way between a slide and a roll. That is, the material slides in mass or the component parts of the material roll over one another as the material flows. Many factors determine the best consistency of the concrete, but a too wet concrete is a very hard material to handle, and the results in the finished concrete are hard to determine.

Progress on the Hell Gate Bridge

A bridge over the East River which is being built by the N. Y. Connecting R. R., to connect directly the extensive New England system of the New York, New Haven, and Hartford with the Pennsylvania R. R., presents many features of unusual interest. The bridge extends from Port Morris, Bronx, down across the Bronx Kill, where it leaves Manhattan and crosses the East River at Ward's Island and extends across to Stemler St., Long Island. For this work are required extensive viaducts supporting four tracks on both Manhattan and Long Island and across East River a steel suspended arch bridge will be built.

The work was started simultaneously at the Bronx end and at the Long Island end in July, 1912. Work on the Hell Gate arch towers was started in Sept., 1912, and on the viaduct piers on Randall's Island, Ward's Island and Long Island in Feb., 1913.

At present approximately one-half of the masonry is complete on the section between Bronx Kill and Port Morris, with 16 piers and abutments completely finished, ranging in height from 30' to 50' above ground. About 900 ft. of retaining walls of the buttress type, with an average height of 35 ft., are also completed.

No work has been completed as yet on Randall's Island, Ward's Island and Long Island viaducts. The contractor's plants are fully installed and work is well under way. On the Long Island end about 1,000 ft. of retaining walls (having a height of approximately 50 ft. above ground), seven piers and abutments and two concrete arches over streets, are completed.

On the Long Island tower of the Hell Gate arch bridge, the foundation and granite work of the base are about 90% completed. The caissons for Ward's Island tower, having an average depth below water of 90 ft., are at present in process of sinking. No steel work has as yet been erected, but the rolling and fabricating are well under way. At present about 1,000 men are employed in the field on construction of the substructure.

The entire work will require about 90,000 tons of steel and 450,000 cu. yds. of concrete, reinforced with about 5,000 tons of steel rods.

The contractors for the masonry of the East River Bridge Division are Arthur McMullen, Patrick Ryan Const. Corp., and the T. A. Gillespie Co., all of N. Y. C. The contractors for the superstructure are the American Bridge Co., and the McClintic-Marshall Const. Co.

For these notes we are indebted to H. W. Hudson, Mem. Am. Soc. C. E., Engr. of Foundations and Masonry, N. Y. Connecting R. R., N. Y. C.

Twenty-four Good Roads Organizations Join American Congress

Twenty-four of the foremost organizations interested in good roads and the development of farm life have signed the official call for the Third American Road Congress to be held at Detroit, Mich., during the week of September 29. The call sums up the good roads situation throughout the United States and the reasons which actuate the holding of this national convention, as follows:

WHEREAS, the rapid concentration of population in our large cities and the high cost of living are, in a considerable measure, due to bad roads which render farms inaccessible, transportation uncertain and costly, educational advantages limited, and social conditions unattractive; and

WHEREAS, it is estimated that the people of this country are annually expending on the public roads upwards of $200,000,000, a large percentage of which, by reason of lack of system, ignorance of proper methods, and wasteful management, is not accomplishing results at all commensurate with the outlay; and

WHEREAS, the National Government and the various state governments are now endeavoring to ascertain the character of legislation which will best accomplish a maximum of effective road improvement and maintenance coupled with a wise and efficient expenditure of the road revenues; and

WHEREAS, the increasing use of the motor vehicle has brought about problems of construction and maintenance of roads which are exceedingly difficult and for the solution of which the combined wisdom and experience of trained specialists are necessary; and

WHEREAS, the aroused public spirit of the people in behalf of the movement for better roads has found expression in the form of many organized bodies; and

WHEREAS, it is only by a correlation of efforts, and by an exchange of knowledge and experience that the greatest good can be accomplished;

THEREFORE, we, the undersigned, representing the organized road movement of America, hereby join in calling the American Road Congress to hold its sessions in the City of Detroit, State of Michigan, during the week of September 29, for the purpose of giving careful consideration to the subjects of road legislation, both national and state; the administration of public roads throughout America including states, counties, and the smaller subdivisions thereof, and the provinces of Canada; the problems of construction and maintenance; the financial questions concerned with road revenues and their expenditures; the advancement of highway engineering in educational institutions; and other questions, the consideration of which may be of practical aid to the betterment of the public roads of America.

The Signers

American Highway Association, L. W. Page, president.

American Automobile Association, Geo. C. Diehl, chmn. Good Roads Board.

National Grange, Oliver Wilson, master.

National Old Trails Association, J. M. Lowe, president.

Travelers' Protective Association, E. B. Smith, national chairman, Good Roads Committee.

Quebec-Miami International Highway Association, Howard D. Hadley, president.

Omaha, Lincoln, Denver Good Roads Association, S. A. Searle, president.

Southern Appalachian Good Roads Association, Joseph Hyde Pratt, president.

Arizona Good Roads Association, T. G. Norris, president.

Arkansas Good Roads and Drainage Association, W. A. Coker, president.

Greater Colorado Highway Association, E. E. Sommers, president.

Georgia Federation of Road Authorities, Wm. F. Eve, president.

Illinois Highway Improvement Association, W. G. Edens, president.

Indiana Good Roads Association, Chas. C. Brown, secretary.

Kansas State Good Roads Association, Arthur Capper, president.

Kentucky Good Roads Association, Joe F. Bosworth, president.

Michigan State Good Roads Association, P. T. Colgrove, president.

Minnesota Roadmakers' Association, John H. Mullen, secretary.

New York Road Builders' Association, John J. Ryan, secretary.

North Carolina Good Roads Association, Joseph Hyde Pratt, secretary.

Ohio Good Roads Federation, Jesse Taylor, president.

Virginia Road Builders' Association, C. B. Scott, president.

Good Roads Committee, West Virginia Board of Trade, Howard Sutherland, Chm.

Wisconsin Highway Commissioners' Association, H. J. Kuelling, president.

"National Aid" and "National Highways" will engage the attention of the delegates to the American Road Congress during one session of the six which will be held at Detroit. It is expected that former U. S. senator, Jonathan Bourne, Jr., chairman of the Joint Committee on Federal Aid in the Construction of Post Roads, will place before the Congress his plan for lending the credit of the national government to the states through the ultimate issuance of a billion dollars of good roads bonds. Senator Swanson, of Virginia, also a member of the Joint Committee, will explain his plan for an annual cash appropriation conditioned upon an equal appropriation by the states and an equal division of responsibility for construction and maintenance. The Shackleford plan, given great prominence by D. W. Shackleford, the chairman of the Roads Committee of the United States House of Representatives, will also be explained to the delegates. Mr. Shackleford's plan provides for a system of rewards on all rural delivery roads meeting certain requirements. Differing from all of these schemes is that which provides for a system of national highways built and maintained entirely at the cost of the national government. A champion of this plan will also be heard. After the presentation of the various schemes now advocated for adoption by the government, discussions will be had and an endeavor made to harmonize differences and, bring about the announcement of a definite policy for submission to the Congress of the United States by the American Road Congress. As a majority in both the Senate and the House of Representatives favor some form of government aid it is considered important that this national gathering of good roads workers should take definite action.

Detroit is planning a notable series of social events in honor of the American Road Congress. These will comprise banquets and informal entertainments by the Board of Commerce, The Wolverine Club, The Adcraft Club, and The Rotary Club, a public reception at which all of the delegates in attendance at the Congress may have an opportunity to meet the distinguished guests from Canada and the United States, and a boat ride and smoker on one of the huge excursion boats plying on the Detroit river, as well as numerous automobile excursions to points of interest in and about Detroit. The citizens of that enterprising city claim that nowhere in the world is the climate so delightful as in Detroit during the first week in October.

Logan Waller Page, director of the U. S. Office of Public Roads, will read a paper at the Road Congress on the "Selection of Road Materials." Before he was appointed to his present post, Mr. Page assembled at Harvard University the first road material testing laboratory in America, following his studies at the French School of Roads and Bridges, and his name is now identified with some of the best known apparatus for road material tests.

A subject which will be taken up at the contractor's session of the Road Congress, at Detroit, which should prove of special interest to road contractors is the Protection and Upkeep of Road Equipment. An immense amount of money is lost through failure to protect and properly maintain costly road machinery and equipment. Another subject which will be presented by a trained specialist is the Organization and Arrangement of Working Forces. It is quite a problem to place the road hands of a big force so as to avoid waste of time and money and this subject should bring out much useful discussion. A special committee of three of the most prominent engineers and contractors identified with contract work of which J. R .Wemlinger, Secretary

American Society of Engineering Contractors, is chairman will have charge of the program of the contractor's session.

The American Bar Association and the American Bankers' Association have each authorized special committees to co-operate with the management of the American Road Congress in the holding of sessions at Detroit to deal respectively with road legislation and the financing of road improvement. An effort will be made at the legislative session to bring about the formation through official channels of a national committee to codify state road laws and recommend simple and uniform legislation for each state and the elimination of the great accumulation of conflicting and confusing road laws. The finance section will endeavor to have adopted in all parts of the country simple and effective methods of road accounting and a record of such cost data as may be essential to the proper conduct of road work, and will also deal with the important subject of bond issues.

Concrete Institute Annual Meeting

The annual meeting of the English Concrete Institution was recently held in London. The report of the council showed 947 members, 37 students, 6 special subscribers and 16 honorary members. The work of the Institute is to be expanded in accordance with recommendations of the Improvement Committee. The meetings during the year were most successful, the average attendance at the general meeting being 60% greater than at the previous session. The report goes on to show that many of the Institute's suggestions as to buildings of concrete and reinforced concrete in various parts of England have been received with favor by the local Boards having the matters in question in charge.

Various committees on Finance and General Purposes, Science, Tests, Volumentary matters, and Reinforced Concrete were appointed by the council to act during the coming year. The Council has had under consideration various suggestions of the Improvements Committee for improving the status of the Institute, and it has decided to ask the general membership to sanction the alteration and amendment of the Conditions and Rules of the Institute in respect to the addition of other members consisting of (a) Associate Members; (b) Associates. The Council has decided to increase the subscription of future members to two guineas ($10.22) per annum, the entrance fee being maintained, as already decided, at one guinea, [illegible]

The Improvements Committee also has under consideration the drafting of a syllabus and regulations for the examination in structural engineering, which it has been decided shall be held in the future for the admission of students to the Institute.

The standard notation for calculations for reinforced concrete, which was drawn up by the Science Committee, has continued to meet with favor, and in extension of the principles contained therein an interim report on a standard notation for calculations in structural engineering generally was submitted for discussion at an ordinary general meeting.

Concrete Organizations, Officials and Conventions

American Concrete Institute, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa. Convention, Chicago, Feb. 16-20, 1914.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Building, Washington, D. C. Meets as part of American Road Congress, Detroit, Sept. 30-Oct. 6.

American Road Builders' Association, Secretary, E. L. Powers, 150 Nassau St., N. Y. C. Convention and Exhibition, First Regiment Armory, Philadelphia, Dec. 9-12, 1913.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Building, Philadelphia, Pa.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy.-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill. CHICAGO Show, Coliseum, February 12-21, 1914.

Iowa Association of Cement Users, Henry H. Dean, Glenwood, Ia., Secretary.

Nebraska Cement Users' Association, Secy.-Treas., Frank Whipperman, Omaha, Neb. Convention Feb. 2-4 and Show Jan. 30 to Feb. 4, 1914, Omaha.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Bldg., Minneapolis, Minn.

The American Concrete Institute

Following instructions of the Kansas City and the Pittsburgh conventions to effect a change in the name of the National Association of Cement Users, the Board of Direction announces that the charter of the association was amended on July 2nd, 1913, so that the name of the association is now changed to the American Concrete Institute.

The Committee of Management of the International Engineering Congress, San Francisco, 1915, takes great pleasure in announcing that Col. Geo. W. Goethals, Chairman of the Isthmian Canal Commission and Chief Engineer of the Panama Canal, has consented to accept the Honorary Presidency of the Congress and will preside in person over the general sessions to be held in San Francisco September 20-25, 1915.

The MacArthur Concrete Pile & Foundation Co., N. Y. C., has been awarded the contract for the concrete piles required in the foundation of the new Ash St. Bridge, Toledo, O.

NEW BOOKS

Wright on Quantities. G. Alexander Wright, San Francisco, Cal., 9" x 6", paper bound, 16 pp.

This book is a reprint of an address given before the General Contractors' Assn., of San Francisco, and points out comprehensively and forcibly the great waste entailed in present systems of estimating. Modern construction work is figured by the average man under average conditions usually in a very short time and under great pressure. Under such conditions, the figure as submitted becomes little more than a refined guess, and no matter how carefully the contractor records cost data of previous work, making a careful analysis of time and labor on work already up, these data are wasted when applied to quantities figured in a great hurry. The paper points out the method followed by quantity surveyors, and shows the efficiency and economy effected by having one professional surveyor estimate the quantities required. In such cases, this quantity survey is furnished with the blue print and specifications of the work. Consequently to prepare a figure all the contractor has to do is to price the quantities.

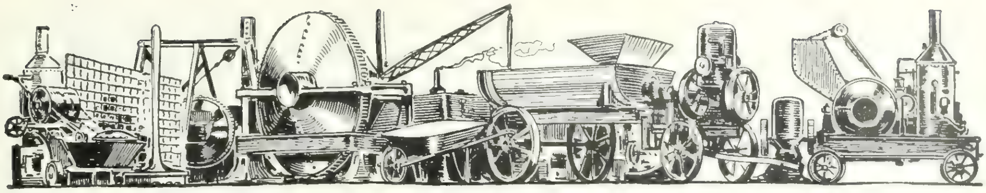
It might be added in passing that the Assn. of U. S. Quantity Surveyors has been formed, with headquarters in N. Y. C. Of this Association, the author of the above paper is president.

Industrial Arts Index, Published by The H. W. Wilson Co., Minneapolis, in February, April, June, October and December; 6¾" x 9¾".

This new publication, to be issued five times a year, its second issue now available, is a cumulative index to engineering and trade publications and should be especially valuable in all reference libraries. Forty-nine periodicals are so far elected for indexing, CONCRETE-CEMENT AGE representing the cement and concrete field.

Technologic Paper No.12, of the Bureau of Standards—Action of the Salts in Alkali Water and Sea Water on Cements. By P. H. Bates, Chemist, and A. J. Phillips, Assistant Chemist, Bureau of Standards, Washington, D. C., 10" x 7", paper bound, 158 pp., illus.

See the Information Consultation Department this issue for extensive quotations in discussion No. 318.



New Equipment, Methods and Materials

The forward progress of any industry is measured by the tools with which it works, and the engineer-manufacturers who are developing new and better methods and materials, merit recognition and co-operation. In this department are published brief descriptions of the new developments of the field

Stirrup Bending Machine

Much of the accuracy in the position of reinforcing bars in beams and girders depends upon the way the stirrup is made. The accompanying illustrations show a machine which has been in successful use for some time to bend stirrups accurately and at a low labor cost. This bending machine in a very ingenious way makes use of a jointed parallelogram. An examination of Fig. 1 shows in full line the position of the machine when the stirrup rods are in place ready for bending. The adjustable holes which determine the angle of the wing are shown at *a*; *b* is the slot in which the bolt *g* can be moved so as to regulate the height of the stirrup; *c* is the link connecting the latch to the frame of the machine; *d* is the stop which regulates the angle of the bend; *e* indicates the holes by which the machine is attached to the bench; and *f* the handle of the lever arm. The four corners of the parallelogram are indicated by P^1, P^2, P^3, P^4. This equipment is known as the "Wilson Bending Machine."

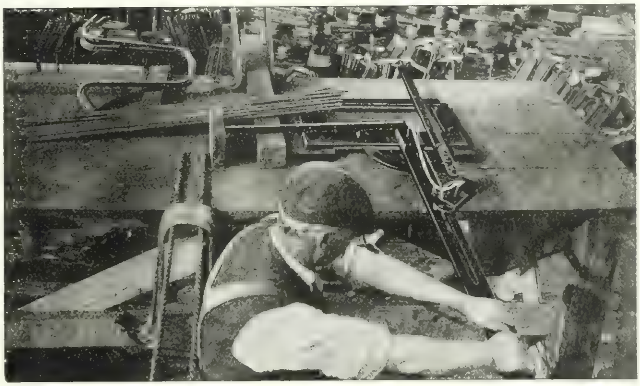


Fig. 2—This Shows the Finish of the First Movement, Making Two Complete Bends in Each of These Bars at One Operation

In operation the bolt *g* is adjusted for the height of stirrup required and the rods cut to length are placed in the machine as shown. Usually three rods can be bent at a time. The handle *f* is swung around to the position shown in the dotted line, which, at one operation, makes two bends. This operation is shown in Fig. 2. The stirrups are then reversed and placed in the machine and completed as shown in Fig. 3.

This machine has been used by the Turner Construction Co., N. Y. C., which has had this machine on its work for the last two years. In a letter to the Concrete Steel Co., N. Y. C., which handles this bending machine, D. H.

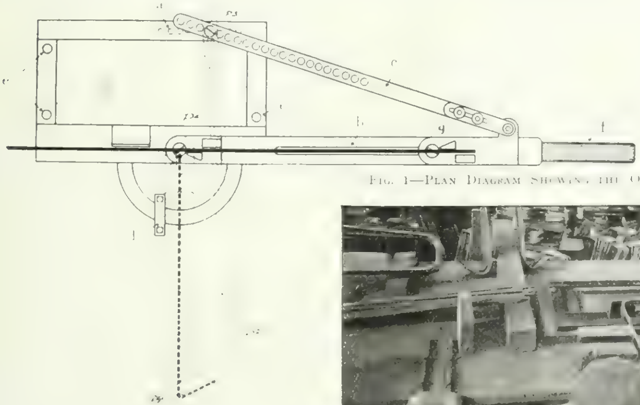


Fig. 1—Plan Diagram Showing the Operation of a Stirrup Bending Machine

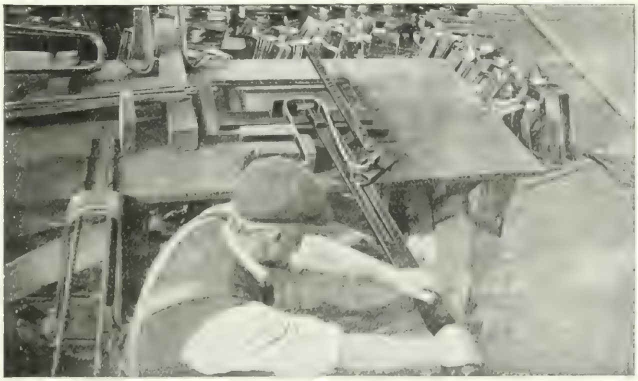


Fig. 3—The Finish. Three Stirrups are Completed at One Operation

Dixon, 2nd vice-pres. of the Turner Co., describes the operation of the Wilson bending machine as follows:

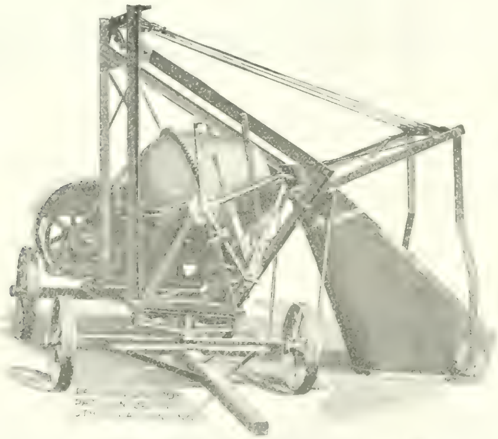
> "Under the old single-bend method of hand work we found that a metallic lather, working 8 hrs. would bend from 300 stirrups to 500 stirrups per day, while with the Wilson bender, making two bends at one time, and also bending several stirrups of the smaller sizes in the same operation, we find it is easily possible to bend from 1,200 to 2,000 stirrups per day with the same labor conditions."

An advantage of this machine is that it does not require skilled labor to operate it, and all stirrups bent with one setting should be identical in shape.

A Small Mixer With a Side Loader

Small mixers are rapidly taking a place in the construction field as standard equipment, and manufacturers now are equipping the smaller machines with the time and labor saving auxiliaries which heretofore have been found on the larger machines only.

The "Little Wonder Five," manufactured by the Waterloo Cement Machy. Corp., Waterloo, Ia., scored a success by the adaptation of the tilting drum principle to mixers designed to take the place of hand work, and yet of sufficient capacity to answer the requirements of the average small contractor. The addition of a side loader to this machine places it in the class of mixers which will do practically any job that offers, while it detracts nothing from the facility of moving about, which is one of its most valuable features.



Little Wonder Five Batch Mixer with Side Loader

The side loader bucket as shown is filled at the ground level, while the previous charge is being mixed and dumped, instead of shoveling into the drum after each discharge. The capacity of the drum is 5 cu. ft. Without the side loader the machine turns out from 35 cu. yds. to 50 cu. yds. per day, according to the efficiency of the crew, the arrangement of forms, etc. As the side loader practically doubles this capacity the advantage of the additional equipment is obvious. Control levers are grouped so that one man can load, tilt and dump the drum and attend to the gasoline engine, which runs continuously.

The drum of this machine has many points of construction that save power and insure long service. One of the most important is the ball bearing on which the drum revolves, and it is interesting to note that this is the only bearing, because commonly the drum of a mixer is supported by several bearings. These ball bearings are underneath the drum and protected from dust. Inside the drum there are four immovable blades, which make cleaning an easy matter. The drum has a very wide mouth, which removes all guesswork as to the consistency of the mix, since the process is in full view and easily regulated. The drum is evenly balanced and can be dumped directly into forms in many cases, owing to the light weight and easy portability of the machine. This latter feature is of great advantage in work where the amount of concrete to be mixed does not justify setting up a large machine. The mixer is readily installed in basements or on upper floors of buildings. Its closely coupled trucks allow turning in narrow places, and it is of great utility even on large engineering projects when the heavier work is done and only the lighter work remains.

* * *

SelFurr Expanded Metal Lath

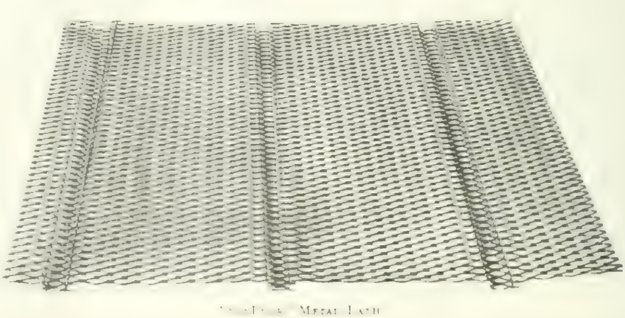
The use of metal lathing has assumed vast proportions in the past few years, due to its fireproofing qualities, reinforcing advantages and the saving in material and labor. Plaster applied over metal lath nailed directly on wood studding or sheathing has been found unsatisfactory owing to its tendency to crack. Various types of metal furring strips have been developed for the purpose of furring metal lath away from the wood and thus avoiding this cracking.

"SelFurr" is, as its name implies, a self-furring lath. Dovetail corrugations are formed in expanded metal sheets on 8-in. centers. These corrugations are formed by a process that does not distort the mesh work between the corrugations but leaves it smooth and level for easy plastering. The dovetail corrugations are easily attached to the supporting surface and act as furring strips to hold the expanded mesh work away from the wall surface.

Adjacent sheets of SelFurr lath are locked together at sides and ends, the corrugations registering and being sprung into engagement at the lap. This saves time and material in wiring or lacing sheets, and gives continuous reinforcement in every direction. This tends to prevent cracking so often noted in stucco work, which most generally occurs following the lap.

The dovetail corrugations fill and are embedded by the application of plaster applied from one side only; the plaster when hard is rigidly locked within the dovetail corrugation, forming small reinforced concrete beams, while the steel strands in the panels reinforce the slab portions between these small beams.

"SelFurr" is manufactured by the Edwards Metal Structures Co., Kansas City, Mo., in No. 24 and No. 26 gauges, and can be had plain, painted and galvanized.



SelFurr Metal Lath

Concrete-Cement Age

Vol. III SEPTEMBER, 1913 No. 3

Editorials

CONCRETE AFFORDS the cheapest durable material for highway construction. In almost all localities and fully considering the fact that hard, clean aggregate costs more in some places than in others, a concrete road made out of the best materials for the purpose, is still the cheapest even in first cost. It is now generally recognized even by the men who sell brick for paving purposes that good highways cannot be built to withstand the wear of modern traffic without the use of concrete. Naturally, those who have other materials to sell at higher prices, argue that concrete is not a durable surface material. We might publish pictures of brick pavements full of pot holes and of cracks, both longitudinal and transverse. We might call attention to the lack of uniformity in the products of the brick kilns. It is lack of uniformity which makes brick pavements go to pieces. Brick are made which will stand a severe wear and laid right along side of them are brick which are soft—brick from the same manufacturer. The soft brick opens the way to destruction. To build a good pavement of other materials than concrete, they first demand a concrete foundation. With a little more care in the selection of the materials of which that concrete base is made, the surface of a different material may well be eliminated. Cracks are not especially characteristic of concrete streets and highways, neither are soft, worn spots. A very small portion of the expense entailed by an additional heavy surfacing material, put into the quality of the concrete base, makes that base a durable pavement. But let us not ask that it be made too cheap. Make it of the best obtainable material, placed after the most approved methods, and concrete is still the cheapest durable pavement in first cost and certainly the least expensive to maintain.

* * *

WE HAVE always believed concrete to be hard, but a recent letter from manufacturers of rotary electric drills has added some first-hand opinion which should be of interest to CONCRETE-CEMENT AGE readers. The electric rotary drill manufacturers state that they are prepared to supply machines suitable for drilling marble, slate or limestone, but in their experience it has been absolutely impossible to get a cutting edge to stand up when trying to drill concrete. Concrete, they state, is of an entirely different consistency and some grades of concrete are as hard as flint. A rotary cutting edge is impractical and a rock drill with a reciprocating motion is essential. This is an interesting opinion of the hardness of concrete.

* * *

IT IS INTERESTING that at the meeting of the Third International Road Congress, held in London, the home of the original successful production of Portland cement, that a paper on "Concrete Road Construction" should be read by an Amreican engineer. A. N. Johnson, State Engineer of the Illinois Highway Commission, was the author of a most interesting paper on the subject above referred to, which was listened to with great attention by the road authorities gathered from all parts of the world to attend the great Congress.

Service Conduits in Highway Construction.

About a year ago we suggested in these pages a type of highway construction that would offer a sub-surface conduit which might be used for gas, water, electricity, telephone, steam, etc., and which, reached through man-holes at convenient spacings, would eliminate the necessity of tearing up city pavements. The suggestion developed considerable comment at that time, and it appeared that the proposition was not quite as radical as it seemed, for in many localities work is being done along very similar lines. In covering the waterway of Jones Falls, Baltimore, City Engineer McKay is using a subway underneath the sidewalk to carry various service lines. Very interesting also in this connection is a paragraph in a recent issue of the *Daily Consular and Trade Reports,* in which Consul J. I. Brittain, Prague, Austria, states that the Department for Public Works at Prague, in order to prevent the frequent tearing up of pavement, annually invites certain public service corporations to a meeting at which all matters pertaining to contemplated improvements under the various corporaiton heads for the following year are discussed. The corporations include the telephone and telegraph department, electric light and electric car service, gas companies, pavement department of the city, and representatives of public water service.

The sub-sidewalk space in Prague is used for the telephone, telegraph, and electric light wires, and also in some streets for gas pipes and for the connection of the sewers with the buildings. The report further states that the city of Prague is going to make a trial of the method used in London, Hamburg, and a few other large cities, where conduits are used 63" wide and 74.8" high, made of concrete, in which all wires, tubes, etc., are placed, with the exception of gas pipes.

The telephone and telegraph wires in Prague are placed in separate larger conduits and the electric light wires in other conduits under the sidewalk. These conduits have frequent manholes which can be opened for examination of wires. The water and gas mains are placed in the streets. The telephone and telegraph system is owned and operated by the government. The electric light and electric car service plants are owned and operated by the municipality of Prague. The city is paved throughout with granite blocks laid in sand. There are no asphalt or concrete pavements.

* * *

Making Form Bolts From Reinforcng Bars

On a [illegible] work mentioned in one of our recent issues the forms were held in place by bolts made from ½-in. round reinforcing bars, bent at one end and threaded at the other Whether or not this would be more expensive than purchased bolts it is an open question, but at many times it is impossible to get bolts when they are wanted and in the proper lengths required, and with threading equipment on the job and an anvil and forge, bolts of any length could be produced as needed.

* * *

Concrete Paving in Kansas City

Readers of CONCRETE-CEMENT AGE are already more or less familiar with the fact that Kansas City has been a leader in the use of concrete as a city street pavement. Information as to this paving and the low cost was published in the September, 1912, issue, the information having been supplied by Clark R. Mandigo, Asst. City Engr. Mr. Mandigo has an article in a recent issue of the *Engineering News* in which he comments on concrete paving, mentioning the fact that Kansas City put down about 15 miles of the work in 1912 and that this record will undoubtedly be equalled this year. The particularly interesting thing which Mr. Mandigo has to say about concrete paving in Kansas City is in his viewpoint of the general usefulness of the material. He takes the stand that it is a good, cheap pavement for new parts of the city which cannot afford an expensive pavement and he recommends putting it down as is being done largely in Kansas City, low enough so that the concrete may be used as a base for another surface later on. The concrete being used in this work is a 1:2½:4½ mixture of cement, sand and limestone, and the average cost of the work last year for the pavement 6" thick was $1.23 per sq. yd. The actual cost of the one-course work was lower than this because the average is obtained by figuring in the cost of some two-course work at $1.47 per sq. yd. If the results in Kansas City are so satisfactory that a large amount of this work is demanded and these results have been obtained with a lean mixture, giving concrete which shows rather pronounced abrasion, then why can we not expect equally satisfactory service for such heavier traveled streets with a mixture offering more resistance to traffic?

Attention is called to the tests made with the paving determinator owned by the Detroit Department of Public Works, an account of which was published in the June, 1913, issue, p. 270. Not only these tests, but experience with actual traffic conditions seem to show that any mixture leaner than a 1:2:4 cannot be expected to give good results under traffic which is at all heavy, but that a satisfactory wearing surface can be maintained even under severe conditions with a mixture of 1:1½:3, using clean, coarse sand and coarse aggregate, consisting either of washed gravel or graded crushed limestone ranging in size from ¼" to 1½".

* * *

The Keokuk Dam Across Mississippi Completed

The greatest power development in the world has been in operation since August 26th, when President Wilson dedicated the new hydro-electric power plant at Keokuk, Ia. A great concrete dam at this place has harnessed the Mississippi river and will make it produce 300,000 horse power, which will be transmitted through the surrounding country, even as far as St. Louis, which is 144 miles away. The Des Moines rapids which extend above Keokuk about 12 miles develop a total fall of about 23 ft. These rapids are bordered with bluffs close to the river on either side for quite a little distance above the dam site and the area overflowed by the backed up water is comparatively small.

The construction of this dam has been under consideration for over 50 years and the development of this hydro-electric plant has been the one endeavor of a good many prominent men for a long time. With the development of reinforced concrete the construction became an economic possibility, and made available this wonderful horse power at low cost in the heart of what has been heretofore a purely agricultural section. This territory has good competitive transportation to all the big centers of distribution, and the area around Keokuk is destined to become a great center. The heart of the entire development is a reinforced concrete dam.

* * *

Important Construction in New York State

While much stress is laid upon the wonderful engineering work of the Panama Canal, both in point of excavation and in concrete construction, writers in engineering papers have recently been calling the attention of the readers to the fact that engineering work of almost equal magnitude is being done in the State of New York in the reconstruction and widening of the Erie Canal.

This is, however, but a single engineering feat, and when the history of construction within the last decade in New York is considered it might well be stated that the reconstruction of the Pennsylvania and New York Central terminals in the metropolis have practically taken as much money, or very nearly so, as the construction of the Panama Canal, while the enormous work of the subway system of the Interborough and the Hudson-Manhattan have furnished almost as large an investment in important engineering work. Add to this the expenditure within the last 15 years on the Croton Aqueduct and the new Catskill Aqueduct and their tunnels through the city of New York and it may well be stated that there is hardly any place on the surface of the earth where as much money has been put into tunnels, canals, railroad terminals and water improvements as have been recently so invested within the borders of the State of New York.

CONCRETE-CEMENT AGE will have a booth at the Road Congress in Detroit, Sept. 29 to Oct. 4. We shall be glad to see road builders.

Concrete Pavement on Superior Boulevard, Extending Out Into the Country From Minneapolis, Minn.

Concrete Road Building—Four Fundamentals

There seem to be four cardinal considerations in the proper construction of a concrete road:

A subgrade which is compact and well drained.

A concrete which has a mortar that binds firmly and an aggregate which is highly resistive to abrasion, so placed that these two qualities are most available where they are most needed.

Methods of curing which insure the fullest possible development of the strength of the material.

Joints in the work which are filled with an elastic material and so protected at the edges as not to break down under the impact of traffic.

Subgrade

The subgrade, the foundation, is of first importance—not merely because its preparation is the first operation, but because all the good work which may follow is seriously impaired by a neglect of what precedes it. The subgrade must be firm, compact, and well drained. Cracks in concrete roads are more often the result of improper drainage in, or insufficient compacting of the subgrade, than anything else.

Concrete

Concrete must be sufficiently tough to resist the varied abrasive influences of traffic. The mortar in this concrete must be sufficiently strong so that the hammering of traffic —for even on a comparatively smooth surface there is, in a degree, a hammering action—will not dislodge the wearing particles in the surface. Nothing should be required of the mortar, in an ideally built road, but to keep the pebbles or the crushed stone in place. Mortar should not be called upon to resist abrasion, yet there should be sufficient mortar to make a perfect matrix for the stone. The stone should be hard enough to resist so far as possible the abrasion of traffic. To get these two qualities, a mortar which binds and a stone which wears, it is necessary that the material shall be hard, clean and well graded. All road builders will soon be convinced that the supply of gravel which is available nearest to the work is frequently an unsuitable material. A washed, graded material should be used. It is at once the most expensive and the cheapest. Occasionally nature has a deposit of material already washed and graded. Yet even nature cannot be depended upon to *run true*, all through the bank or the pit. In one-course work it has been found that a mixture of 1 part cement, 1½ parts sand and 3 parts stone (crushed or pebbles, ¼" to 1½") gives a satisfactory result under laboratory tests with simulated and accelerated traffic and under actual conditions of traffic wear. Experience has seemed to indicate that uniform hardness in aggregate, is the thing to be desired. A few soft pebbles may start a hole just as one soft brick threatens the life of a large area of brick pavement. Though probably desirable, a one-course pavement is not essential. It is often possible to get sufficient aggregate of high quality for a top course when the price would be considered prohibitive for its use throughout the entire work.

The mixture as it goes into the work should be wet but not sloppy and be worked so as to secure density—a perfect matrix—and so finished as to make the mortar bind and the stone wear, at the same time securing a true surface, for any unevenness greatly accelerates the action of impact and abrasion.

Curing

The concrete once laid, should be properly cured. It must not dry out rapidly. It must be covered from the sun and wind and kept wet during the early period of hardening.

Joints

The joints are still a moot question only in the sense that there is a growing disposition to leave them out of the pavement altogether. It may in time be found better practice to lay a pavement with no provision in the way of transverse joints for expansion and contraction and to maintain the joints which nature afterward creates, than purposely to provide joints at the outset. Yet conservative judgment seems to be in favor of the creation of joints at predetermined intervals, 25', 30' or perhaps 40' and provision made in advance for their protection and maintenance. Inasmuch as this is being done satisfactorily at a moderate cost in the use of steel protective plates and an elastic filler, this practice undoubtedly should be followed until such experiments as those of the United States Office of Public Roads form a safe basis for different practice.

United States Government Experimental Road

Construction Notes and Cost Data on Concrete Road Work at Chevy Chase, Md.

While the satisfactory use of expansion or contraction joints in concrete pavements has been all but solved—solved in the sense that a means has been found to protect the edges of the joints and a satisfactory though not entirely permanent means of filling the spaces—there is the settled fact that they are still the weakest part of the work, and to be able to build a satisfactory concrete roadway without them or with the least possible number of them, would be an important advantage. Thus the experiments conducted on the Kensington or Chevy Chase road, Washington, D. C., by the U. S. Office of Public Roads, continue to hold a large amount of interest. Logan Waller Page, Director of the Office of Public Roads, proposed a concrete road without joints with the idea that if it is not found practical to continue in their disuse at least it may be determined what is to be their proper spacing. Specifications for this work have been previously published in CONCRETE-CEMENT AGE.[1] The construction of this experimental road which included several other sections besides those of cement concrete was begun last fall (1912) and was not completed until the spring of this year. As an introduction to construction notes on the concrete work supplied by Jas. T. Voshell, Sr. Highway Engineer of the Office of Public roads, we quote from a Progress Report prepared before the work had been completed and issued by the Office June 30, 1913.[2]

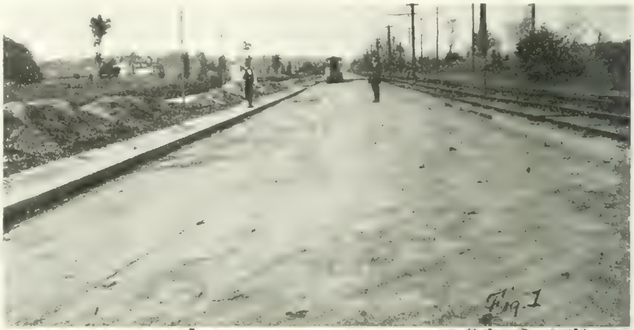
Experiments at Chevy Chase, Md., 1912

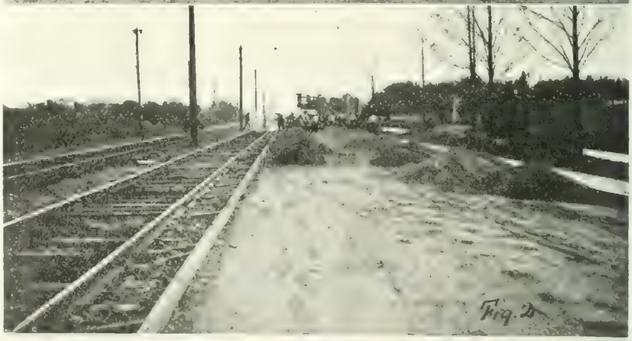
The 1912 experiments at Chevy Chase, Md., form a continuation of the experimental sections constructed during 1911. They were conducted upon a section of Connecticut Avenue, 6,195′ in length, beginning at Bradley Lane, and extending north to the loop of the Capital Traction Co. tracks at Chevy Chase Lake.

The work was begun on September 9, 1912, and was continued until December 13, 1912, when, owing to unfavorable weather conditions, it was discontinued. A length of 4,561′ was partially completed.

The section of Connecticut avenue selected for the experiments is on the west side of the tracks of the Capital Traction Co. and was formerly an 8-in. water-bound limestone macadam road. A cobble gutter was laid along a part of its length on the west side, but was provided with no outlet in practically the entire length of the section. When the experimental work was begun, the road had worn into a series of large depressions and was in an intolerably dusty condition.

This old surface was spiked up with a steam roller and broken with a plow and a scarifier, and the excavation and shaping of the subgrade were completed by hand labor. French drains 3′ deep along the car track and 2′ deep under the





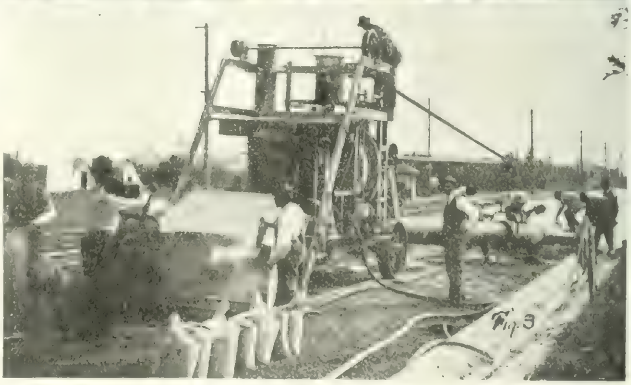


Fig. 1—Subgrade Prepared for Pavement
Fig. 2—Sand and Broken Stone Aggregates on Subgrade. Dirt at Side of Road to be Used Later in Covering Concrete
Fig. 3—Charging End of Mixer

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[1] Specifications [illegible] bituminous surface, oil cement concrete and cement concrete (untreated surface) in Sept., 1912, issue, p. 52. Specifications for the other sections together with drawings showing typical cross sections were published in the December, [illegible] issue, [illegible].

[2] Office of Public Roads, Circular No. 99

gutter supplied sub-drainage where it was required, and the stone removed from the old road surface was "shaken out" and used in the drain trench. A concrete gutter of the "barrel" type, 3′ wide and 4″ deep, was laid along the west side of the road, and the distance from the outside of the rail to the outside edge of the gutter was 25′ 9″. The gutter, as constructed, formed a shoulder for the pavements, and consisted of a base of concrete in the proportions of 1 part by volume of Portland cement to 2 parts of sand and 4 parts of gravel, and a top course of ½″ of mortar in the proportions of 1 part by volume of Portland cement to 2 parts sand.

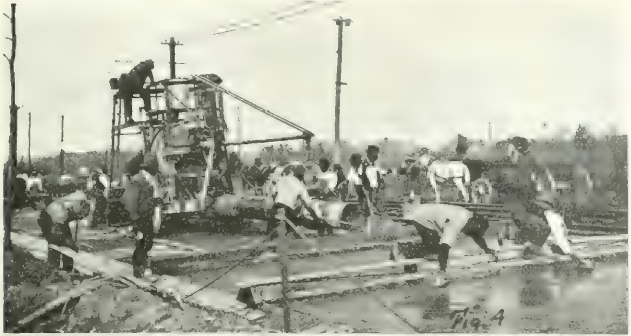
The experimental pavements were laid adjoining the gutter and on the foundation, which was prepared as described above. A single contract was awarded upon plans and specifications[1] prepared in the Office of Public Roads for the construction of six experimental sections, as follows:

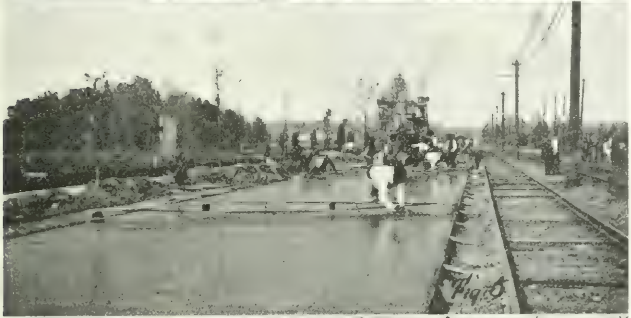
Section 1.—Bituminous concrete (Topeka specifications).
Section 2.—Bituminous concrete (District of Columbia specifications).
Section 3.—Cement concrete, surface coated with bituminous materials.
Section 4.—Oil-cement concrete.
Section 5.—Cement concrete.
Section 6.—Vitrified brick.

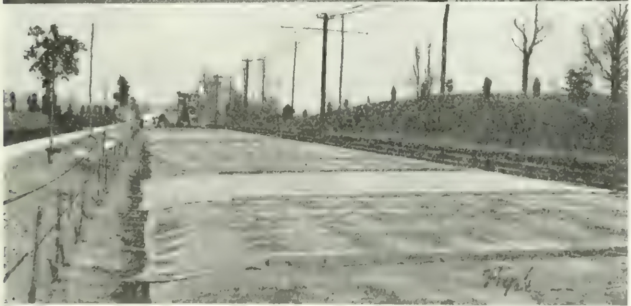
Sections 1 and 2 were entirely completed; section 3 was completed with the exception of applying the bituminous surfaces; sections 4 and 5 were partially completed; and section 6 was not begun.

The equipment consisted of a concrete mixer of the self-propelled rotary-distributor type, two 200-gal. heating kettles, a patented hand distributor, pouring pots, two 10-ton rollers of the 3-wheel type, a 10-ton and a 3-ton tandem roller, a scarifier, plows, and hand tools. Efficient labor was furnished and the work was done as expeditiously as possible, but considerable time was unavoidably lost by reason of unfavorable weather conditions and the delayed arrival of materials.

Experiment No. 3.—Cement Concrete—Surface Coated with Bituminous Materials—This section of bituminous concrete, D. of C. specifications,[3], is 1,253′ in length, and contains 2,837 sq. yds. The concrete was mixed in the mechanical batch mixer described under experiment No. 1 in the proportions of 1 part of Portland cement to 1¾ parts of sand and 3 parts of coarse aggregate. Between stations 12+50 and 15+84 and between stations 21+60 and 25+03 a gravel aggregate was used which consisted of particles of stone well graded in size between those retained on a screen having ¼-in. circular openings and those passing a screen having 1½-in. circular openings. It was also provided that not more than 75% should pass and not more than 75% be retained on a screen having ¾-in. circular openings. Between stations 15+84 and 21+60 a crushed limestone aggregate was used which consisted of that part of the run of the crusher which was retained on a screen having ¼-in. circular openings and which passed a screen having 1½-in. circular openings. The method of mixing was the same as that described under experiment No. 1, except that a greater quantity of water, in an amount necessary to give the concrete a "quaky" consistency, was added. The concrete was spread evenly over the subgrade with rakes and shovels to a depth slightly greater than the finished thickness of 6 inches, and the surface was then "struck off" by means of an especially designed "strike board." After this the surface was finished to true grade and cross section with a wooden float. The floating was done from a bridge which rested upon the side forms and the concrete gutter and could be advanced as the work progressed. Joints between the days' work were formed by placing







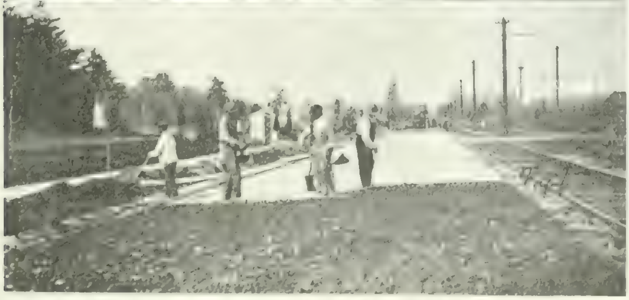


Fig. 4—Discharging [illegible] of the Mixer; Spreading and Bridge in Use
Fig. 5—Floating Surface of Concrete
Fig. 6—Canvas Covering in Place to Prevent Concrete From Drying Out Too Rapidly—Removed When Concrete Was 48 Hrs. Old
Fig. 7—Removing Canvas and Covering Pavement With Dirt

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[3] The description of this section and that of section 1, bituminous concrete, Topeka specifications, are included in Bulletin 99, but are [illegible]

a [illegible] edge at an angle of 80° to the center line of the road. Before continuing the work of laying the concrete the plank was removed and the face of the joint was washed with a 10% solution of muriatic acid, followed by water.

As soon as practicable after laying the pavement it was covered with canvas and was so protected until the concrete had thoroughly set. The canvas covers were then removed and the concrete was covered with a layer of loam or sand about 2" in depth, which was kept thoroughly wet for a period of eight days. The covering was allowed to remain on the pavement for a period of 15 days after which it was removed whenever it was convenient to do so. Loam was at first used for this covering, but it was found to be difficult to remove it entirely, and sand was therefore adopted as a covering on all sections which it was planned to cover with a bituminous carpet coat.

Experiment No. 4—Oil-Cement Concrete—This section was constructed in two parts and is not yet completed.[4] It adjoins the former section at station 25+03 and extends to station 33+60, where it is interrupted and is continued from station 42+50 to station 44+61. The length of the part constructed is 1,068' and it contains 2,430 sq. yds.

From station 25+03 to station 27+29 and from station 42+50 to station 44+61 a coarse aggregate of crushed limestone was used. From station 27+29 to station 33+60 the aggregate used was gravel. The character of the materials used and the method of construction were the same as described under experiment No. 3, with the exception that a light residual petroleum, having the characteristics represented in Table 13, was mixed with the concrete to the amount of 5 pts. per bag of cement.

TABLE 13.—[illegible] residual petroleum [illegible] *ment No. 4*

Specific gravity [illegible]	0.933
Viscosity, Engler, 50° C., 100 c. c. specific	[illegible]
Per cent [illegible] grams)	[illegible]
Float test of residue, 32° C. (time)	1'35"
Per cent of total bitumen insoluble in [illegible]	2.31
Per cent of fixed carbon	3.01
Per cent soluble in CS_2 (total bitumen)	99.90
Per cent of organic matter insoluble	.08
Percent of inorganic matter insoluble	.02
Total	100.00

The total length of this section as planned is 1,350'.

Experiment No. 5—Cement Concrete—This section lies between the two parts of experiment No. 4 and extends from station 33+60 to station 42+50, a distance of 890'. It comprises 2,011 sq. yds. The materials used and the method of construction were the same as described under experiment No. 3. (The entire section as completed is 1.350' long.)

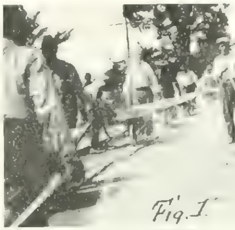
[illegible] at Chevy Chase, Md.—When inspected in March, 1913, all of the surfaces were in excellent condition. Transverse contraction cracks had developed throughout the length of the gutter and at varying intervals throughout the several sections of concrete pavement. About 50% of the cracks in the latter had formed at the same point as cracks which had already developed in the gutter before the pavement was laid. Pavement cracks occurred at less intervals throughout the plain gravel and oil-cement-gravel concrete than in the sections where limestone aggregate was used, but this may possibly be due to the fact that the latter sections were laid in colder weather and were consequently less liable to con-

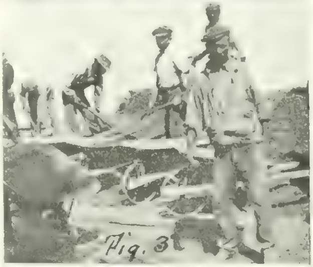
(*Continued on next page*)

Road Building Kinks

BEHIND THE MIXER

Wayne County, Michigan





When a large party of Illinois contractors came recently to inspect the Wayne county road work, some of them were inclined to believe that the gang behind the mixer wheeling gravel and sand was bigger than necessary. Fig. 1 is from a photograph taken on the Warren road job, July 26, the day the Illinois contractors visited the work. Fig. 2 was made on the Michigan road, Aug. 15, Fig. 3 at Grosse Pointe, Aug. 12, and Fig. 4 also on Michigan road, Aug. 15. The fact of the matter is that on the Warren road, where, as some of the contractors said, the men with the wheel-barrows were stepping on each other's toes, an extra effort was being made to get the work done up quickly and the men in charge of operations were working the men in relays. The operations were being pushed very rapidly in shifts of 12 hrs. and as the weather was exceedingly warm, it was impossible to keep one gang continuously up to the higher speed, which was wanted, hence more men were kept on the job than were ordinarily needed. This is the explanation offered for that situation by one of the county road commissioners. However, the other three pictures seem to show similar conditions. They cannot, however, be said to be typical pictures in the sense that they show exactly how the men work. It must be said in fairness to the method of organization, that when a man appears upon the scene armed with a camera, the average laborer makes every effort to get in front of it. For instance, the fellow whose wheel-barrow is shown pointed straight at the camera at the left in Fig. 3 went out of his way a half a dozen times to get in front of the camera when the picture was being taken. So the pictures really show more bunching than actually exists.

The number and organization of the gang behind the mixer presents a serious problem and the number of men needed to get the gravel, cement and sand into the skip of the mixer on schedule time, varies constantly with the nearness of the supply of these materials to the mixer. If, in dumping sand and gravel along the roadway, unusual care is taken to space the materials as they will be needed and to keep up that spacing continuously, it is not so difficult a matter to get the organization of the gang behind the mixer in such shape as to have no stepping on toes, but when there is a surplus of material and again a little further on a scarcity of material, or rather when it is necessary to wheel further to get the material, the situation is constantly changing with respect to the number of men required. In each one of these gangs, there were about 30 men behind the mixer, and two-thirds of that number probably would have been enough if the material had been properly spaced all the time, but in order to keep the mixer going and not hold up the finishers, it is necessary, it seems, to have a larger gang on hand than is needed *all* the time. There seems to be this suggestion, that it might pay to have a high priced man to regulate the unloading of materials, to figure to a nicety the precise amount of gravel and sand which should be dumped per linear foot of road.

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[4] *Was* not completed when this progress re- [illegible]

traction from a fall in temperature during the early period of hardening.

In connection with this experimental concrete roadway, an interesting set of observations is being taken on the change in length of the concrete. It is hoped that by accurately measuring the change in length of the concrete roadway, due both to temperature and to moisture, data of practical value will be obtained to permit more efficient spacing of the so-called expansion joints.[5]

[The following notes, made after the completion of all the work, were supplied by James T. Voshell, engineer in charge.]

The work was done precisely as directed in the specifications except that the concrete was mixed in the proportion of 1:1¾:3 instead of in the proportion of 1:1½:3½ as specified. A trial was made of mixing the concrete in the latter proportion, but it was found that there was not enough mortar to flush to the top and completely fill the surface voids, and the proportion of 1:1¾:3 was found, after several trials, to be the most satisfactory.

These final proportions were such that when the concrete was run into place and puddled by shaking it with a rake and later tamping or jostling it with the strike board sufficient mortar was brought to the top to fill all surface voids. The concrete was quite wet—soft enough that if one stepped on it after it was placed he would sink into it 3 or 4 in.

During the process of striking off and floating considerable water ran off of the concrete into the gutter at the side. When the surface was completed it had just the appearance that a concrete sidewalk has after it is floated off preparatory to final troweling. Now the thin mortar top has worn off and the pavement has a mosaic appearance.

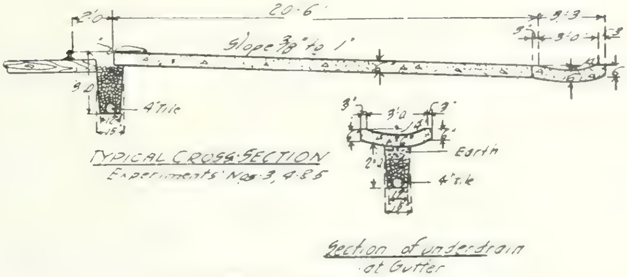
Analyses of Materials

Following are granulometric analyses of samples of sand, gravel and stone used in the pavement:

	Gravel	Stone
Retained on 2" sieve	[illegible]	[illegible]
Retained on 1½" sieve	2.3%	0.0%
Retained on 1¼" sieve	13.1%	0.0%
Retained on 1" sieve	[illegible]	[illegible]
Retained on ¾" sieve	[illegible]	[illegible]
Retained on ½" sieve	89.3%	66.7%
Retained on ¼" sieve	99.1%	91.6%
Retained on ⅛" sieve	0.9%	95.0%
Passing [illegible] sieve	[illegible]	[illegible]

Sand	
Retained on ¼" sieve	0.0%
Retained on [illegible] sieve	[illegible]
Retained on No. 10 mesh	13.9%
Retained on No. [illegible] mesh	[illegible]
Retained on No. 30 mesh	46.5%
Retained on No. 40 mesh	67.0%
Retained on No. [illegible] mesh	[illegible]
Retained on No. 80 mesh	97.5%
Retained on No. 100 mesh	98.7%
Retained on No. 200 mesh	99.7%
Passing No. [illegible]	[illegible]

The concrete was protected from drying out as directed in the specifications. When sprinkling was stopped and the concrete began to dry out transverse cracks appeared and practically all of the cracks that now exist in the pavement formed during drying out of the concrete. During the fall of 1912, 3,312 lin. ft. of the concrete pavement were laid and in March, 1913, the average length of the monolithic sections was 43' where the coarse aggregate was gravel and 121' where it was broken limestone. There is no noticeable difference as to the frequency of cracks between the plain concrete and the oil-cement concrete sections.



[illegible]

Development of Cracks

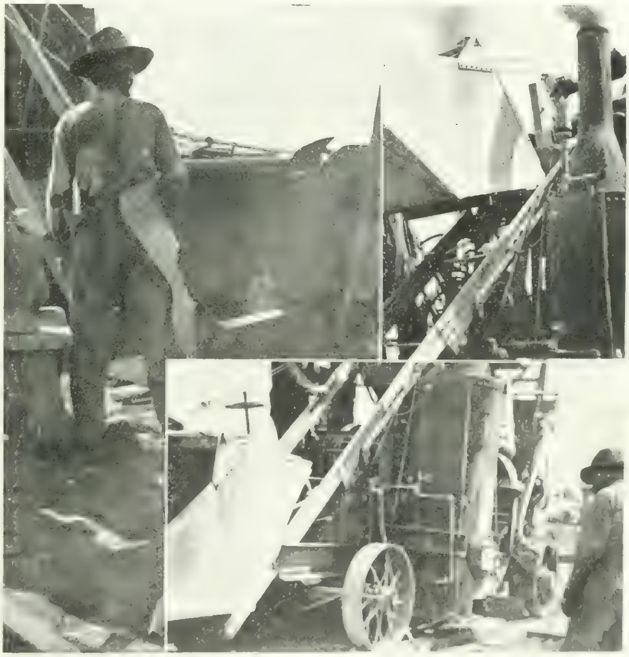
A concrete gutter without expansion joints was laid, as shown on the plans, at least 30 days before the concrete pavement was laid. The gutter cracked, upon drying out, into sections about 15 ft. in length. When the concrete pavement was laid the concrete was placed directly against the concrete gutter and later it was found that more than half

(Continued on page 130)

Road Building Kinks

Wayne County, Michigan

THE MIXER



When a [illegible] road [illegible] put in with a big gang of men the mixer keeps rolling back pretty often. The mixer shown[1] is auto-traction being driven by the big wheel shown at the right of the lower picture. It rolls on heavy 3-in. planks in short lengths which are removed from in front of the mixer and placed around next to the back wheels as the equipment is rolled backward. The views show in detail the loading hopper, the cement and gravel being put in, and the way the hopper comes up the incline track.

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[5] [illegible] Jan., 1912, issue, p. 31

[1] [illegible] ing & Contracting Co., [illegible]

Concrete Road in Maryland

BY H. G. SHIRLEY*

The first concrete road built in Maryland was laid in April, 1911, at Whitehall, Baltimore county, under the supervision of the writer.

The concrete was laid in two courses—a base 5" thick, composed of a concrete mixed 1:3:5, and a top course 2" thick, composed of a 1:2:4 concrete. The sub-base had a cross slope of ¾" to the foot, and was thoroughly rolled with a 10-ton roller until firm and hard, great care being taken that no soft spots existed, and that it was brought to the proper grade. Wooden forms, 7" deep and 2" thick, were securely set along each side of the road, and brought to a true grade. The sub-base was then thoroughly sprinkled, and the concrete laid and tamped to a uniform thickness of 5". Upon this course was spread the top course, immediately following the placing of the first course, and in no instance more than 20 min. elapsed before the placing of the second course. The template was then passed over the top course, bringing it to the proper cross-section.

No floating was done, but the surface was left in a fairly smooth condition, as the sliding movement of the template, both in a longitudinal and transverse direction, brought the mortar to the surface, filling all the voids. The surface was then covered with tar paper, and kept moist for 4 dys.

The size of the stone used in the first course ran from ¾" to 2", and was a hard serpentine. The size of stone used in the second course ran from ½" to ¾", and was trap rock. The sand was clean, coarse and sharp. The ingredients contained in the concrete were all of the best quality, and gave a good, dense mixture.

Expansion or Contraction Joints

Expansion joints ¼" wide were made at intervals in some cases of 30' and some 60', having an angle of 60° with the center line of the road. About three-quarters of the Whitehall job was with 30-ft. joint spacing and the remainder with joints 60' apart. The ¼-in. joints were filled with several plies of tar paper.

Up to the date of this writing, no repairs of any kind have been made on this road, and from a recent inspection, no repairs are necessary, as very little wear has taken place. The only apparent wear is along the expansion joints, and this is so slight it is scarcely noticeable.

This road leads to an important railroad station, from which a gread deal of milk, wheat, and other farm products are shipped, and also carries the general traffic leading to a small thriving country town, having a large flour mill.

State Road

When the writer became chief engineer of the State Roads Commission in June, 1912, no concrete roads had been constructed, and he immediately recommended to the Commission that a few miles be built on the heaviest traveled roads, as an object lesson. Three sections were laid on the Baltimore and Washington boulevard, and several sections at other points in the state. The apparent stability and wearing qualities of this work convinced the Commission that it was superior to water bound or bituminous macadam for the heavily traveled roads, and main arteries of the state.

Since April, 1913, there has been constructed, or is now under construction 45 mi. of concrete roadway, in 13 of the 23 counties of the state. The price per sq. yd. varies from $1.07 to $1.47, and depends upon the availability of materials. The average cost is about $1.24 per sq. yd.

All work completed or under construction has been contracted for under the following specifications, the pitch surfacing being omitted in these contracts.

Concrete Roadway

1. Concrete surfacing shall be used wherever shown on the plans or where directed by the Engineer. The surfacing shall be .... feet wide and .... inches thick at center and .... inches thick at sides.

2. The road-bed for the concrete surfacing shall consist of the natural earth road-bed prepared and rolled with a ten-ton roller until firm, hard and even. If sandy or other soil is encountered which will not compact readily under the roller, a small amount of clay or other material, satisfactory to the Engineer, shall be used until a firm, hard surface is obtained after rolling.

3. In cuts and fills, unless otherwise specially directed, the road-bed shall be graded to the width of 24' and shall be free from all spongy and vegetable matter.

4. The portion of the road-bed prepared for the concrete surfacing shall be .... feet wide and conform to the grades and cross-sections as shown on the plans, and rolled with a steam roller until firm and hard. All depressions which may appear during the rolling are to be filled with earth and re-rolled until an even surface, with a proper grade and cross-section, is obtained.

5. Where no changes are made from the present grade of those portions of the road not already surfaced with stone or gravel, as shown on the profile, the road-bed shall be shaped to the proper cross-section. Slight elevations with contiguous depressions removed so as to form an even, smooth surface. The road-bed is to be rolled with a steam roller to a firm, even surface before the application of the concrete. The portion of the road-bed prepared for the concrete shall be below the sides by the amount equal to the thickness of the concrete.

6. The shape of the road-bed after rolling shall be as shown on the accompanying plan and shall have a cross-slope of ¼" to a foot. Before any concrete is placed on the sub-base, it shall be thoroughly sprinkled until it is in a moist condition.

7. The concrete for the roadway shall be mixed as hereinbefore described

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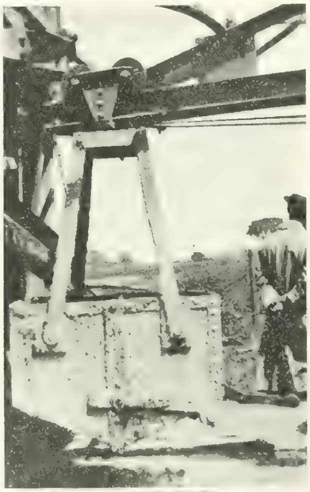
* [illegible]

Road Building Kinks

Wayne County, Michigan

The Mixer Bucket



The design of the bucket used on the mixer is particularly adaptable for this work. It seems to work easily and efficiently. A careful examination of the illustrations, (Warren road, July 26, 1913), will show that the two leaves of the bucket are so hung that when open the bottom blades are nearly in a vertical position. The toggle joint levers used to close up the bucket do not work very hard considering the weight of concrete carried in the bucket. At the top is shown the bucket closed; in the center is the bucket dumping.

under the head of "Portland Cement Concrete Masonry." It shall be proportioned 1 part cement, 2 parts sand, and 4 parts broken stone or gravel. The concrete shall be placed on the sub-grade to the required thickness after being thoroughly tamped.

8. The concrete shall, immediately after being placed, be tamped until the mortar flushes to the surface and no voids whatever exist in the entire thickness of the concrete. Retamping, after the concrete has its initial set, will not be permitted. Contraction joints will be provided to extend the entire distance across the road at intervals of 60′. The concrete shall be placed in these 60-foot sections continuously. In no case shall a greater time than 20 min. elapse between the depositing of two successive batches. Immediately after the concrete has been struck with the template, it shall be finished with a wooden float, and before it has completely hardened, it shall be roughened with a stiff broom or brush. The broom or brush shall be placed lightly on the concrete at the beginning of each stroke. The brooming shall take place at right angles to the center line of the road. The concrete surface shall be covered with tar paper or canvas to protect it from the sun for a period of twelve hours and the concrete shall be sprinkled with water so as to keep the surface moist for a period of 3 days after it has been deposited.

9. Care must be exercised to bring the surface to a uniform cross-section, as shown on the plans, and no depressions whatever will be permitted. To this end, a board 2″ x 5″ shall be placed along the sides of the concrete. The board shall have an angle on the top, and the top of the concrete should be struck with a template. The template should be of the cross-section of the finished road, and the bottom should be protected with an angle iron. Any depressions which exist after striking with the template may be filled with mortar floated into place. The concrete shall not be disturbed in any way after it has been struck with the template. In floating the surface, the men shall work from a temporary bridge which shall rest entirely on the shoulders and shall not touch the concrete at any point. After the concrete has obtained its initial set, the strips shall be removed and the sharp edge pared off.

10. If depressions occur after the concrete has obtained its initial set, the entire thickness of the concrete shall be replaced with new concrete by the contractor, at his own expense.

11. Contraction joints shall be provided to extend the entire distance across the road at right angles to the center line, at intervals of 60′. Contraction joints shall be made in the following manner:

A steel template about 5/16″ in thickness, and having a cross-sectional slope of the finished road, shall be rigidly placed across the road at right angles to the center line, and at the required grade. Against this steel template shall be placed a layer of tar paper having the same cross-section and depth as the road-bed. This tar paper shall be of a quality subject to the approval of the Chief Engineer. After the concrete has been placed in the first section up to the top of the template, a similar layer of tar paper shall be placed on the opposite side of the template, and as the concrete is filled in, the steel template shall be removed, thus allowing the two sections of tar paper to close up against each other. The joint is then to be floated with a float, and brought to the accurate grade and cross-section of the road. After the concrete has thoroughly set for seven days and is thoroughly dry, it shall be spread with ½ gal. of bituminous material to the sq. yd. and entirely covered with stone chips to the depth of ¾″. The stone chips for this surfacing shall be free from dust and shall be such as will pass through a ¾-in. screen and remain on a ⅛-in. screen.[1]

12. No traffic of any description will be permitted on the concrete for a period of seven days after it has been laid. The contractor will erect suitable barriers to prevent traffic from going over the concrete, and any section which is damaged by traffic going over it before the specified time shall be removed and replaced by the contractor at his own expense.

The reason for abandoning the idea of joints at a 60° angle with the center line was that a joint at this angle left at the edge of the pavement a triangular point—an acute angle—which was frequently broken off by a 12-ton roller, where the shoulders were constructed.

Great care should be exercised to see that proper drainage is secured, and where a flat sub-base is used, stone weepers should be placed at intervals of from 50′ to 100′ to carry the water from the sub-base to the gutters.

The concrete should be thoroughly mixed and the aggregate so proportioned, as to give a rich and dense mixture. The curing of the concrete, after it has been laid, is of initial importance, and the period of keeping it thoroughly moist should be extended to at least 10 days in hot, dry weather. The cross section used on all work in 1913 has a flat base, and is thicker in the middle than on the sides, giving the proper cross slope and the greater volume of concrete, where there is the greatest strain. This also does away with the strain in the concrete of pulling its own weight up over the curved section of the sub-base.

In conclusion, the writer, from his experience and close study of concrete road construction, is of the opinion that a concrete road, properly constructed under expert and intelligent supervision, is superior to a macadam road, and when covered with a pitch coating, is superior to a bituminous macadam road. However, if it is not laid with the greatest care in all important details, it will prove a costly experiment, as well as a failure.

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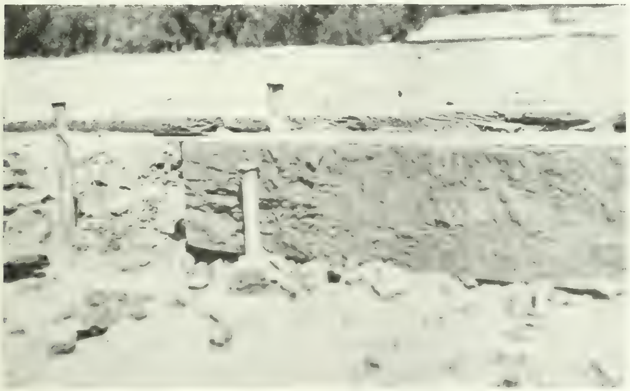
[1] [illegible] thus far

Road Building Kinks

Wayne County, Michigan

SIDE FORMS



This view, taken on the Warren road, July 26, 1913, shows the way side rails or forms are set up. The rails on this job are 2″ x 6″ with an angle iron guard 1½″x1½″. A cord is stretched along the grade to indicate where the rail is to go and the rail is held by iron pins as shown by the illustration instead of stakes. The angle iron laps over the end of the rail so as to protect the joints and make it easy in setting in the next rail to get alignment. The dark abject at the end of the angle is a lead pencil put there to show relative size.

The County Road Commission has been using channel iron rails on some of the work and at the ends these have tongues and slots by which alignment is made easy. These channel irons are 6″ wide and instead of being held by an ordinary straight pin and resting between pins on grade, a pin is used which has a shoulder. When the cord is stretched to grade, these pins are driven in so that the shoulder comes to grade line. The rail then rests on the shoulder and is held by the part of the pin which projects above the shoulder to a little more than the height of the rail. These channel iron rails have been very satisfactory except that the supply used so far was made up of rather light weight metal and they have become somewhat battered and bent.

Road Building Kinks

EXPANSION JOINTS

Wayne County, Michigan

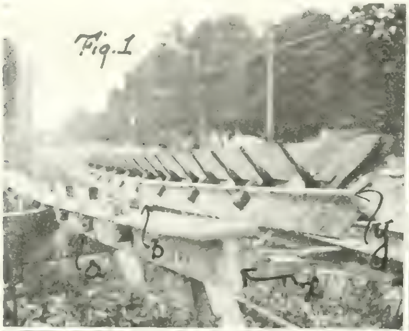


Fig. 1

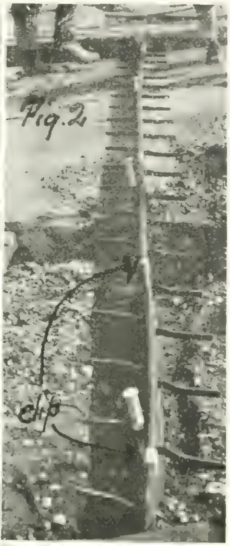


Fig. 2

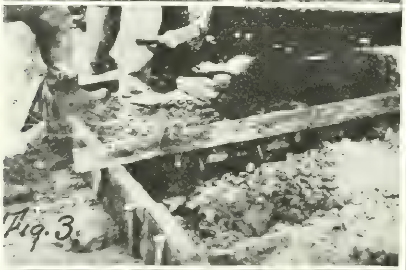


Fig. 3

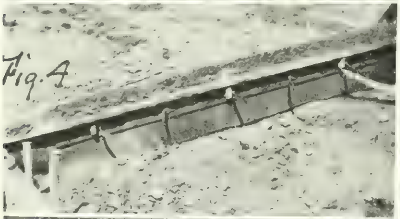


Fig. 4

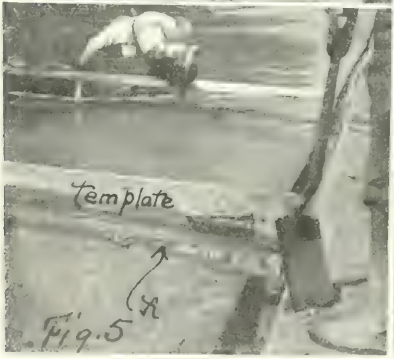


Fig. 5

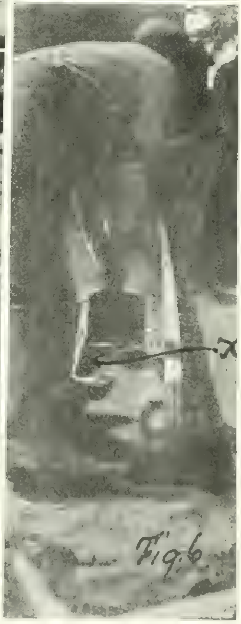


Fig. 6

The operations of preparing and placing the materials which are to fill the expansion joints are shown in these pictures, Figgs. 1-6. The first step in the now approved method of putting in the steel plates and asphalt felt is shown in Fig. 1. The manufacturers of the Baker[1] plates provide a T-iron shown at *x* in Fig. 1. This T-iron has two rows of countersunk finger bolts. The bolt *b* and those in the same row, are immovable, and that at *a* and those in the same row, turn eccentrically. This T-iron is turned upside down in slots in two wooden horses as shown at *x*. The steel plates with the two thicknesses of asphalt felt which have previously been cut to proper widths from regulation rolls, are placed between the finger bolts. A tool is then inserted in holes in the projecting portion of the finger bolts at *a* and these are turned so that they tighten on the steel plates. There has to be a T-iron for each width and crown of road, and the irons are made 4" or 5" longer than is required by the width of the road so that when the steel plates and the felt have been attached as shown at *y*, the entire member is then turned over and set in position with the projecting ends of the T-irons resting on the side forms as is seen in Figs. 3 and 4. With such an arrangement, the steel plates and the felt are pretty sure to be in exactly the proper position, in relation to the surface of the concrete roadway.

When the concrete has been deposited about a 25-ft. section beyond a joint so there is little likelihood of the plates being disturbed, the revolvving fingerbolts are turned, the T-irons released and lifted off. This leaves holes in the concrete next to the joints where the fingerbolts have been. These are promptly filled up by the finishers. In drawing the template over the pavement, the surplus concrete which accumulates has to be taken out with a shovel as soon as the template gets within a foot or so of the T-iron. This is shown in Fig. 6. This T-iron is shown at *x* in the figure, between the shovel and the man's boots.

In Fig. 2 is an entirely different construction. Practically all of the work used to be done in just this way, but it isn't done this way any more because the use of the T-iron has been found to be such an advantage. For the construction shown in Fig. 2 the steel plates with the asphalt felt between are held by little clips and the stiffness of the felt is largely depended upon in placing the joint in the road to hold it temporarily in an upright position. While this is held by one man, another man drives in the pins tight enough and close enough to the joint material so that it is held upright with a fair amount of security. However, it is seldom absolutely straight and it will readily be seen that it isn't straight in Fig. 2, and sometimes it sinks between the pins and has to be lifted up just a little when the finishers get to it.

Among the interesting things shown at the Annual Exhibition at Leipsig are plans of a gigantic tower which it is proposed to construct on the Rhine, and which is to have a height of nearly 2,000 ft., or practically double that of the Eiffel Tower. It is to be in the middle of a special bridge across the Rhine on two arches, and the tower, which is to be built of steel, is to rise to this great height, forming a monument for the sight of Rhine travelers.

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[1] R. D. Baker Co., Detroit, Mich.

Some New York State Concrete Roads

Notes on Completed and Incompleted Work; Quotations from the Specifications

STAFF ARTICLE

EDITORIAL FOREWORD

To avoid any possible misunderstanding of the comments made in the following article on concrete highway work in progress on one particular road and the comments on the specifications in force, the author desires to make it perfectly plain that the examination of the work in progress and the examination of the road built last year, both were made on the afternoon of July 23 and were casual in nature. The conditions noted are those which would be apparent to almost any interested person. The comments are not on concrete highway work in general in New York State. On the afternoon of July 22 the author made inquiry of Mr. Strong, division engineer at Syracuse, as to any jobs under construction which were not too difficult of access from Syracuse. He was referred to the Cicero-Baldwinsville work. At that time Mr. Strong gave the impression that the concrete roads thus far built were giving a fair degree of satisfaction; he mentioned that cleaner material probably should be used than had been available in some instances and he particularly mentioned the difficulty in cleaning concrete surfaces for the application of bituminous surface materials and the fact that it had been hard to get these materials to stick. He commented upon the fact that the public demanded rapid construction—wanted roads, more roads, and quickly; that contracts had been let hurriedly in the winter months and that next year screened materials undoubtedly would be required.

Concrete-Cement Age has no quarrel with anybody or anything except methods and materials which do not seem to give the best results possible with concrete. The comments in the following article are published solely with the idea that if New York State specifications are found to be somewhat loose, or that the work is being rushed in some cases to the detriment of the public, then the public may be persuaded that it should defer to the better judgment of the engineers in charge of public work, that if necessary the initial investment in highways shall be greater so that subsequent maintenance charges may be less. Contractors should not be blamed for not doing the best possible work if the best possible work is not required of them. An honest contractor, and most contractors we believe are honest, will much prefer an iron bound specification—a specification which is truly *specific,* a specification which is followed up with rigid inspection, so that in bidding he may figure definitely on the best work and not have to take into consideration the possibility that some contractor bidding against him may evade and get away with it.

The comments which follow are not intended to put any blame on contractors or engineers. They are intended to focus attention on conditions in certain specific cases with the idea that these conditions may lead the proper persons to inquire if all is being done which should be done to give New York State the best possible highways for the least cost. It is possible that the work being done comes up to every requirement of the New York State Highway department. If this is so, then it is our belief that the department should require more. It is only natural, perhaps, in New York State, where the maintenance cost of roads has been in the neighborhood of $1,000 per mile per year, with macadam construction, that the public generally should regard with some complacence the more recent concrete work, which, while in some cases is apparently not up to the standard being attained in other parts of the country, is nevertheless offering them a good highway the year around. A longitudinal crack extending almost continuously for a mile and numerous pot holes where the pebble aggregate has been torn loose from its matrix are things which may not immediately concern the convenience of the public. In view of the rather low cost at which concrete roads have been built in New York State it may be that too much should not be expected. However, when we know that the expenditure of perhaps 25% more in initial cost, in consequence of specifications and close inspection requiring a better mix, clean materials and proper curing, would give a concrete with far more than 25% more wearing value, we incline to the belief that New York State should have more for its money—not more roads—less, perhaps—but more in the way of quality.

New York State specifications for concrete highways probably will be revised in the near future. Although about 200 miles are either built or under construction, there is evidence, even so soon as a year after the completion of part of the work, that some of the essentials for satisfactory concrete pavement could not have been observed in all cases.

An instance of disappointing results is the road from Cicero to Brewerton, near Syracuse. This was built in 1912 using gravel concrete 5½" thick. A mile or so of the road at the Cicero end is finished off with a carpet surface of asphalt, cut back with naptha, and the remainder of the road toward Brewerton, was given a Tarvia coat of about ½ gal. to the sq. yd. and the usual treatment of screenings. When this road was seen July 23, the photograph (taken May 20, 1913) which is reproduced in connection with this article was a flattering representation of it. The view shown, Fig. 1, is of the roadway in front of a hotel at Cicero. The asphalt cover had adhered rather well but is off in places and the concrete has worn down badly in some spots. Since warm weather came on, the asphalt covering appears to be creeping. Farther on towar Brewerton, the Tarvia coat shows excessive peeling. At that time probably not more than ¼ of the surface was covered. There were long stretches of longitudinal cracks usually very near the center of the roadway; but entirely aside from the additional exposure to wear due to these cracks, the pavement appeared to be breaking up through weakness in the concrete. Pebbles were being thrown out of their mortar matrix and scattered about the road, and there were numerous large holes where the concrete had worn down 2" to 3" in less than one year since the time of construction. One boulder nearly 4" in diameter was seen thrown out of the road leaving a hole in the concrete fully ⅔ it size. The dislodgment of so large a piece of stone would have been almost impossible when so nearly covered as was this one unless either the stone was dirty so that the cement did not bind it, or the mix itself unusually poor.

Dirty Material

The examination of this road, however, was merely superficial and only by noting the conditions of construction on a nearby concrete road, could an idea be gathered as to the causes of the early failure of the Cicero-Brewerton work. This other nearby road is between Cicero and Baldwinsville and extends at right angles to the Cicero-Brewerton road. This work was started at the Baldwinsville end in 1912 but was not completed last fall. Work was begun this year at the Cicero end and when the writer went over the newly built part July 23, a part of the concrete only two weeks behind the mixer was giving signs of what may be expected to be a short life.

Fig. 2 is a view of this Baldwinsville-Cicero road near the Baldwinsville (west from station 68+00) end and was taken May 21, 1913, after the bituminous coat had been put on. The surface shown in the photograph appears to be a good one. This part of the road was not visited.

Fig. 3 shows the Baldwinsville-Cicero road only a short distance behind the construction gang. This photograph was taken May 21, 1913. Figs. 4 and 5, photographs made the same day, show the road west and east respectively from Station 357+50. The view in Fig. 5 shows the wavy and rather poor surface of the concrete before the application of the bituminous coat. In the central foreground of Fig. 5, can be discerned what looks like a little pool occupying about 1/6 of the width of the roadway. This is characteristic of the work which the writer saw put in on this road July 23. The gravel was being taken out of a bank 100 yds. or so back from the road; hauled in wagons directly to the highway; shoveled up in wheelbarrows and into the mixer, one barrow of cement to 6 of gravel, the mixture going out the other end of the mixer in a soupy consistency. The material being used was not by any means clean. A man on the work who said he was the inspector, conceded that the gravel had been running a little poor.[1] The mixture was going on to the roadway so wet that it must have been difficult, if possible at all, to get it to stand up to the proposed crown of ¼" to the foot. Figs. 6 and 7 give an idea of the consistency of the mix and proportioning and grading of materials. Coarser material than is ordinarily used for road work was employed in the mix.

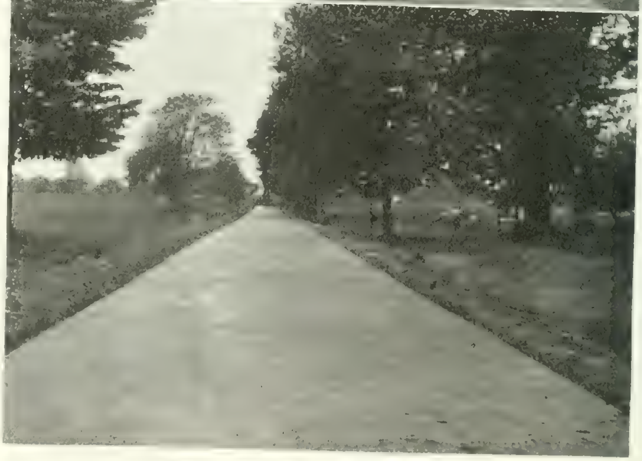
Little pools of water and cement settled on top of the roadway as the work progressed and were not always smoothed up or removed, leaving just such spots as mentioned in connection with been down less than two weeks, showed many small irregular cracks and crazings, some of them more than ⅛" wide into which a pen knife could be thrust an inch to an inch and a half. Two views of the road surface and these cracks are shown in Figs. 8 and 9.

Concrete Cracking

The inspector said that the work was being sprinkled for two days after laying. However, none of the work except that just laid was moist and no sprinkling was evident at the time. The work was not being covered with earth or sand or canvas and was being dried out very rapidly by the sun, this undoubtedly causing the cracks referred to. The surface of the concrete which had been down about a week had very much the appearance of yellow clay which has been drenched by rain and then baked out and cracked in the hot sun. An unfortunate accident is shown in Fig. 10. The wheel and hoof depressions were filled with mortar.

Work is Rushed

Frederick S. Strong, division engineer of the New York State Highway De-



F[illegible] B[illegible] R[illegible] (No. [illegible])
A view south from St[illegible] concrete 6" thick with asphaltic carpet coat, photo made May [illegible], 1913, soon after [illegible]

F[illegible] Baldwinsville Road (No. 1039)
View west from Sta[illegible] May 21, 1913, after bituminous coat was put on

F[illegible] View West From Sta. 356 Before Application of Bituminous [illegible] Photo Made May 21, 1913 partment, at Syracuse, said that the great difficulty with the work which has been done so far in concrete highway construction, has been in the fact that the highways have been demanded by the public in a hurry. Of the 200 miles of highway contracted for in New York State, 90 miles were under contract in the Syracuse division in 1912, and of this 30 miles were finished last year Mr. Strong conceded freely that on some of the jobs it had seemed impracticable to get as clean material as should be used.

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[1] The inspector [illegible] better. In this connection attention is called to various [illegible]

Mr. Strong said that in putting on the bituminous surface there had been a great deal of difficulty in getting it to stick. In some of the roads it had worn off rapidly and he was not sure whether to attribute this to the laitance on the surface of the concrete, due to an excessively wet mix, or to the dirty surface of the road when the bitumen was put on. The work of putting on the bitumen has followed in some cases quite a while after the concrete construction. Mr. Strong said that the cost of cleaning the concrete surface to receive the bitumen in one case was as high as 17c per sq. yd..

On state trunk roads concrete is being put on 6″ thick, on state-county roads the thickness is usually 5″, and some Hassam concrete is being put in 5½ thick. Most of the concrete on this work under state supervision has been at a contract price of about $5.00 per cu. yd. of concrete. All contracts are let on this basis of cubic yardage of material. Prices have ranged, however, as low as $4.25 per cu. yd. and as high as $5.50 per cu. yd.

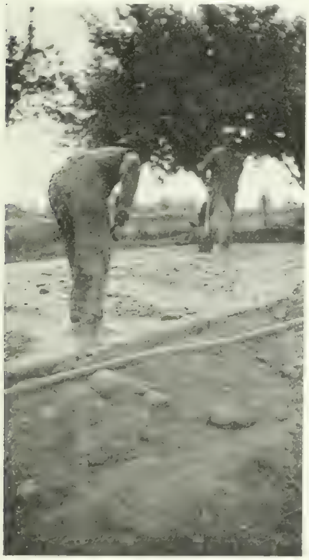
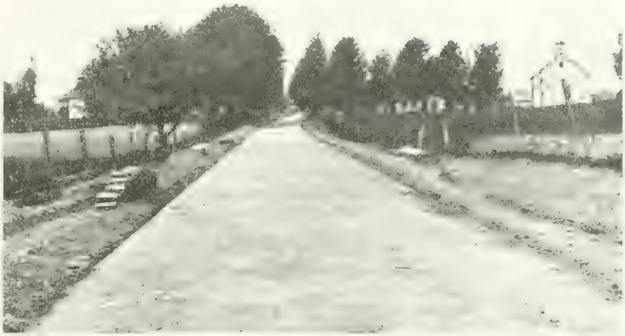


Fig. 7—Cicero-Baldwinsville Road, July 23, 1913

The concrete is patted with a shovel



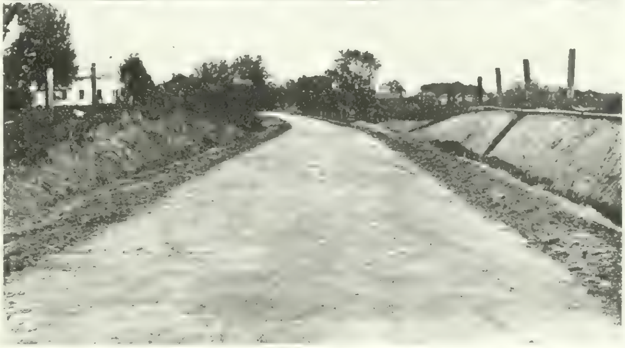


Fig. 4—Cicero-Baldwinsville Road View West From Sta. [illegible], Before Application of Bitumen, Photo Made May 21, 1913

Fig. 5—Cicero-Baldwinsville Road, View East From Sta. 357+50, Photo Made May 21, 1913

Mr. Strong said that numerous contracts for concrete roads were let in the winter when it was impossible, in the short time available, to make proper examination of the deposits of gravel which it was proposed to use, but he said that under the specifications the fact that a deposit had been accepted as suitable for the work, did not mean that the job had to go through on that basis.

He was of the opinion that next year's contracts would require screened gravel and a cleaner material, but he attributed most of the unsatisfactory work to the fact that the entire highway work has been rushed. Last year there were 1,700 miles of highway of various kinds under contract in New York State; 350 miles were in the Syracuse division, of which only 130 miles were completed last year.

Attention was called in Concrete-Cement Age, in the September, 1912,

(Continued on page 141)

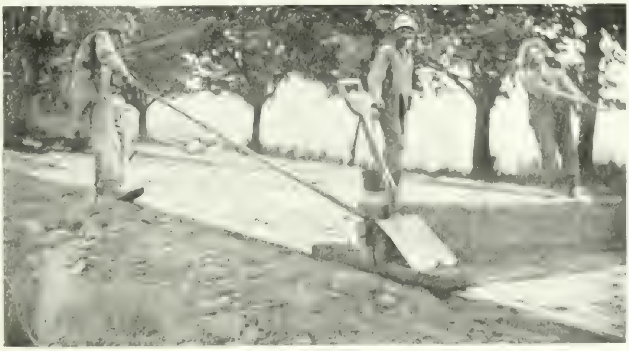


Fig. 6—[illegible] 1913

The [illegible] unted on short pieces of 2-in. plank which slide along the side [illegible] ther clumsily and not too effectively.

Wayne County Concrete Roads

A summary of concrete road building in Wayne county, Michigan, is presented on this page and a map of Wayne county with concrete roads shown in red is shown opposite. In the brief descriptive outline of the different roads all work was done by the Board of County Road Commissioners unless stated as having been done on contract. In these descriptions, details of the 1911, 1912 and 1913 work are not described specifically, when they have been covered in general statements as to specifications and practice in the General Summary which precedes the Detailed Summary.

General Summary

Subgrade—On all concrete roads constructed before 1912, the subgrade was crowned ¼″ to 1′. All work in 1912 and since has been on a flat subgrade. Beginning with the 1912 work much more attention was paid to a thorough compacting of the subgrade.

Concrete—Some of the work done in 1909 and 1910 was put down in 2 courses. All that in 1911 and all since has been of 1-course concrete.

Some of the early work was with limestone for an aggregate and some with unwashed gravel using unwashed sand. Beginning with some of the work in 1910 and in all work of 1911 and since, washed sand and pebbles have been used.

Early wrok was with 1:2:4 mix for one-course work, and in two-course paving, a 1:2½:5 for base and 1:2:3 or 1:3 for top. Beginning with some work in 1910 and in all work of 1911 and since the mix has been 1:1½:3—cement, washed sand and washed pebbles, the latter retained on a ¼-in. screen and passing a 1½-in. screen.

Thickness—Early 2-course work was 6″ and 6½″ thick, the bottom course 4″ and the top course 2″ or 2½″. Early 1-course work was in some cases 6″ thick, in others 7″ and in some 7½″. All work done in 1912 and since, being put on a flat subgrade, was 6″ thick at the edges and was crowned with ¼″ to 1′ so that the center thickness was from 7½″ to 8¼″ in various widths of roadway from 12′ to 18′. The average thickness of the concrete is about 7″[1].

Joints—When the first half mile of road was built on contract in 1909 variout joint fillers were used experimentally—Georgia pine boards, a mixture of asphalt, pitch and stillwax, tar paper, asphalt felt and some joints were protected at the edges with angle irons with asphalt felt between. Subsequently practically all joints were without metal protecting plates and were filled with 2 thicknesses of tar paper or with 3-ply asphalt felt. In 1911 the Baker[2] plate was adopted, using asphalt felt between the plates. Joints all placed at intervals of 25′, transversely of the road, at right angles to the center line.

Surface—Practically all of the work has been given a float finish. The concrete is struck off using a template, conforming to the crown of the road, resting at the ends on the sideforms and manipulated with a sawing motion. The finishers work on a bridge using wooden floats, taking out all unevenness behind the template.

The mix is wet so that workmen, shoveling behind the, mixer sink above the ankles yet not so wet as to make it difficult to keep the concrete up to the crown of ¼″ to 1′.

Contract Work—Some of the work in 1909 and some in 1910 was under contract. Since then the Board of County Commissioners has equipped itself with necessary machinery[3] and has done its own road building, at times employing as many as 1,000 men.

Detailed Summary

Woodward Road: 1909—Wayne county's first concrete road was built on contract as an extension of Woodward avenue, from the limits of Highland Park village northward about 1 mile. Width,[4] 18′; gravel shoulders 3′ 6″; concrete in 2 courses—4″, 1:2½:5, 2″, 1½:2½:3; transverse expansion joints 25′ apart with various fillers, among them Georgia pine boards, a mixture of asphalt, pitch and stillwax, tar paper, asphalt felt and angle irons with asphalt felt between them; cost $1.28 per sq. yd.

1910—Length, extended to a total of 2.213 mi. (to the county line); width 18′; shoulders 5′; 2 courses—4″, 1 cement, 2½ sand, 5 crushed cobbles; cost $1.287 per sq. yd.

Grand River Road: This road carries the heaviest commercial traffic, metal tired farm vehicles predominating.

1909—Length, ½ mi. (beginning northwest of macadam road which lies between the concrete and the city limits); 1 course, 6″, 1:2:4 mix; asphalt felt expansion joints 25′ apart; cost $1.31 per sq. yd.

1910—Work done on contract; length, approximately 2 mi.; width 16′; shoulders 4′; 2 courses—4″, 1:2½:5 and 2″, 1:2:3; asphalt felt joints 25″; cost $1.204. This work not entirely satisfactory; worst worn stretch of 300′ has since (1912) been covered with Tarvia coat and sand.

1911—Length, 13,255′ (included in this is 8,000′ of road built for Redford township[5] to replace an equal distance of 9-ft. wide road built the year before on contract for Redford which had to be torn up, the work being entirely unsatisfactory) width 16′; although at this time the flat subgrade had not been generally adopted for Wayne county work, it was used in this case, with concrete 6″ thick at edges and 8″ in center; 1 course 1:1½:3, washed sand and pebbles. This road has shoulders 4′ wide. Steel protective plates with asphalt felt were used at joints. Cost, $1.72 per sq. yd.

1912—Length, approximately 6 mi. (to county line), making a total of 10.13 mi.

August 9, 1913, the 2½ mi. of 1911 work had developed 25 transverse cracks and 7 longitudinal cracks and the 6 mi. of 1912 work, 33 transverse cracks and 52 longitudinal cracks, such as could be seen while driving slowly over the work in an automobile. These cracks were, to a great extent bunched and many of them occurred at the bottoms of grades.

Wayne Road South: 1909—Length, about ½ mi.; 1 course, 1:2:4; cost, $1.08 per sq. yd.

1911—Length, ½ mi.; width 15′; shoulders, 4′. Although washed sand

(Continued on page [illegible])

Road Building Kinks

Wayne County, Michigan

Consistency

This view (Warren road, July 26, 1913) is taken to show the consistency of the concrete. It is not run too wet, yet so soft that men standing in it sink above their ankles. It is worked over to the side-board with a spade as shown and constantly patted to produce a dense concrete. Then the template comes along, manipulated so that besides its movement in the line of the work there is a sawing motion. This is shown in other views, however.

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[1] [illegible] in the Sept., 1912, issue. Concrete has not [illegible]

[2] [illegible] Baker [illegible]

[3] See *Concrete*, October, 1911

[4] Width in each case refers to width of concrete.

[5] See *Concrete*, Nov., 1911, issue, p. 47

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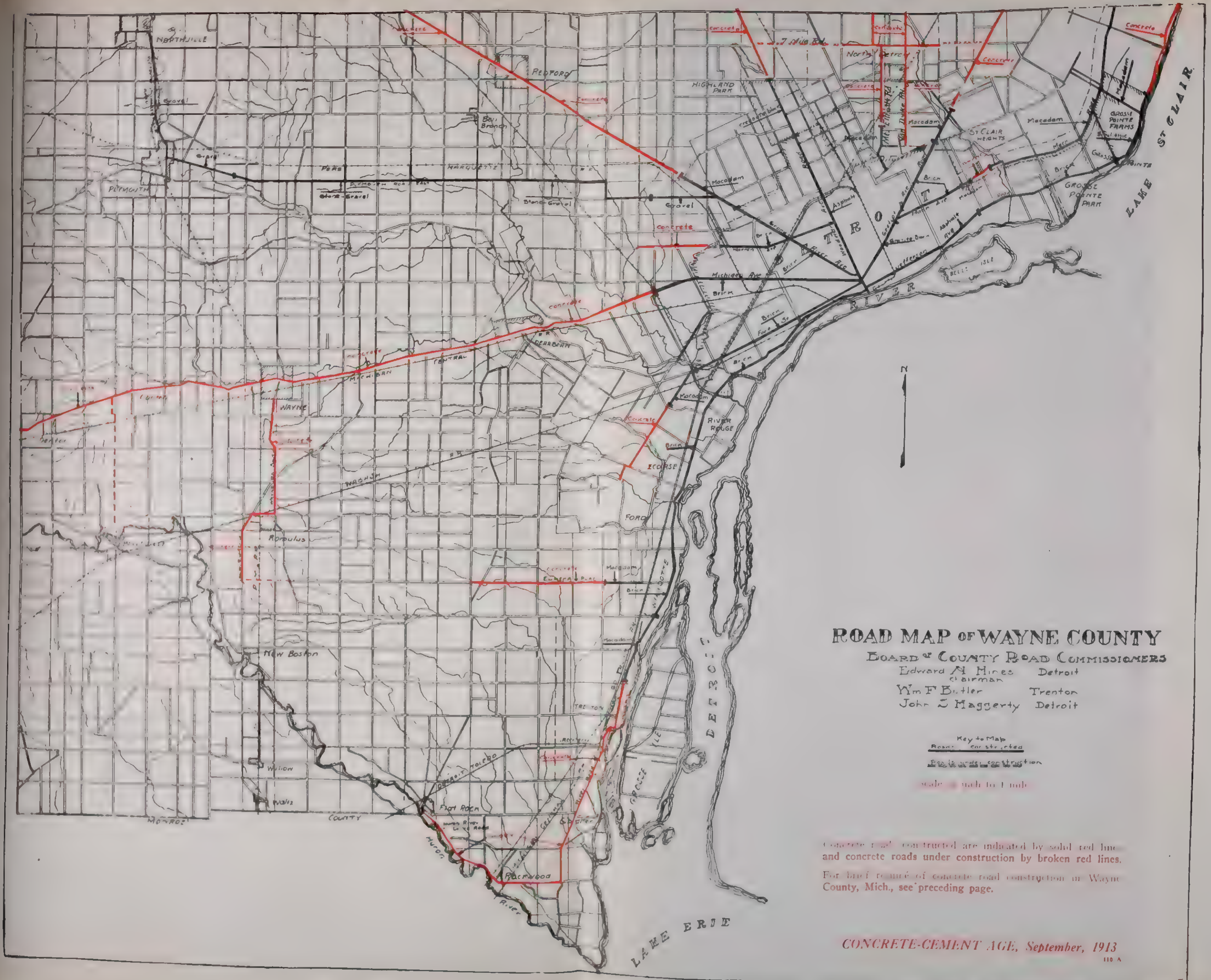

ROAD MAP OF WAYNE COUNTY

BOARD OF COUNTY ROAD COMMISSIONERS
Edward N. Hines, Chairman — Detroit
Wm F Butler — Trenton
John S Haggerty — Detroit

Concrete roads constructed are indicated by solid red lines and concrete roads under construction by broken red lines.

For brief resumé of concrete road construction in Wayne County, Mich., see preceding page.

Essentials In City Pavements of Concrete

On this page two city engineers—each of them with a national reputation in the line of which they write—tell for Concrete-Cement Age how they built concrete pavements which please taxpayers. They tell tersely the essentials which they believe belong to successful work.

Essentials of Reinforced Concrete Paving—the Experience in Fond-du-Lac.

BY J. S. McCULLOUGH*

Some of the things I have found to be essential in concrete pavement construction are:

The sub-grade must be adequately drained and rolled until all depressions are taken out. A uniform compression should be the aim, and on placing a pavement over a wider area than has formerly been traveled care should be taken to get that portion outside of traveled track, as solid as the center of roadway.

When gutters are put in, we require same amount of rolling and compression under curb and gutter as under pavement proper.

The material to be used for aggregate in concrete must not only be clean when delivered on the work, but must be kept clean until it gets into the work. Work has been ruined by allowing clay, loam or other ruinous materials to get mixed into stone, gravel and sand, after it was dumped on the road or street. Our specifications (Fond du Lac, Wis.) require stone and sand to be deposited on planking on the street, and kept clean until used.

Cement should be carefully watched, and frequently tested on the job to guard against insufficient grinding, and also to detect cement damaged in transit, or in warehouse by getting damp or wet. We test our cement for pavement work as it is received, and inspector on street looks out for any particular defective sacks that may have got wet, and partly set.

Where expansion joints are left to be filled later with asphalt extreme care must be exercised in removing templates used to make space. There is danger of pulling up part of concrete in removing the templates and such damaged spots will soon ravel and develop bad holes and ruts. We use a patented wedge for this purpose which enables us to make the space for expansion without any damage to concrete, and the removal of the wedge is no trouble at all.

Our work is all two-course work, and in order to get the top course or wearing surface of the desired uniform thickness we use an adjustable gauge, cut to desired crown of street, which travels on the gutter or curb, as desired and gives us a uniform crown and thickness. This gauge is also used to test sub-grade, and there is no excuse with its use for not getting thickness of concrete called for by specifications.

For wearing surface our idea is that 1½" thickness in a special rich mix for wearing surface with granite for aggregate, and sand and cement mortar, making a mix of equal parts cement, sand and granite, laid on a base of 1:2½:5 concrete will produce a better pavement, than the same amount of cement put into a one-course job.

We have no washed gravel available, and our limestone is rather soft, so have continued to build two-course work, with granite, sand and cement wearing surface. In our clay soil the changes in sub-base on account of moisture and frost and the temperature changes, have convinced us that a 6½-in. thickness of slab is not strong enough, and we have been reinforcing with a No. 7 triangle mesh wire.[1]

For next season's work we have in mind increasing both thickness of slab, and the weight of reinforcement, and put all the crown of the pavement in the concrete, by making sub-grade flat.

Our pavements are standing well, and the only defect we are trying to overcome is the tendency to crack longitudinally. The cracking does not appear to be a serious defect in the opinion of taxpayers, however, as we have been building concrete pavements in this city since 1908, and with the exception of our first year's work, the pavements have all been laid on petition, from abutting property owners.

We have approximately 10 miles of concrete pavement in the city now, and have petitions granted and on file for more than 3 miles for next year.

Plain Concrete Paving—What Has Been Learned From Mason City Work

BY F. P. WILSON

I have tried here to set down, from my experiences and several years of investigation, what I deem *necessary* to obtain satisfactory results in the construction of cement concrete pavements. The important essentials which should enter into the construction of concrete paving are:

1—To have the sub-grade thoroughly drained where it is necessary, by using farm drain tile not less than 4" in diameter, after which the sub-grade should be rolled and compacted with a heavy steam roller until it is perfectly solid over its entire surface.

2—After the sub-grade has been prepared, great care should be taken to keep it wet, before placing the concrete, as a dry sub-grade draws the moisture from the concrete mixture and is thus harmful.

3—Have a first-class Portland cement that will stand the tests required by the American Society of Civil Engineers.

4—Have a sharp, clean sand, which does not contain more than 2% of loam.

5—Have a good hard limestone or other stone equally as good, free from dust, loam or clay, and crushed so that it runs from ¼" to 1¼" in size, 66% of the stone to be the coarser and 34% the finer of the stone aggregates.

6—For the base concrete, use the proportions as follows:

1 part Portland cement by measure.
2 parts sand by measure.
5 parts stone by measure.

7—The fine aggregates and coarse aggregates should be thoroughly mixed with a good batch mixer, until all stone is coated and is of such consistency that all it requires, is to level off the mass so that the concrete runs into place, no tamping being required and a dense, compact volume is obtained.

8—For the wearing surface use the proportions as follows:

1 part Portland cement by measure.
1 part screened sand by measure.
1 part screened, ¼ in. crushed granite.

The proportions to be thoroughly mixed to a proper consistency with a good batch mixer.

9—After the concrete or base has been placed, put, on immediately the top or wearing surface so that there is a complete bond between top and base.

10—Have an expansion joint 1" in width left next to the curb on each side of the street, this space to be filled with an asphalt filler. Have transverse expansion joints ½" in width left every 37' 6" at right angles with the curbs, these expansion joints to be protected on either side with steel plates 2½" in depth, ¼" in thickness, with a shear member 6" in length cut out of the sides of the plates at equal distances and bent at right angles and extending into the concrete, these steel plates to be not less than 10' in length. Between these plates place a 3-ply tar felt paper especially prepared for the expansion joint.

11—A contraction or blind joint should be left every 12' 6" at right angles with the curbs, these joints to be clear through pavement from top to bottom, on the top or surface of pavement the joints floated over and not lined or corrugated.

12—For the crown of concrete streets use the same crown that is used on the other kinds of pavements for different widths of roadways.

13—The wearing surface should be finished off with a wood float made of a coarse grained soft wood, so as to give a uniform rough surface which will give a good foothold.

14—The curing of concrete pavement is one of the most important features and on it depends the durability and strength. A concrete pavement must

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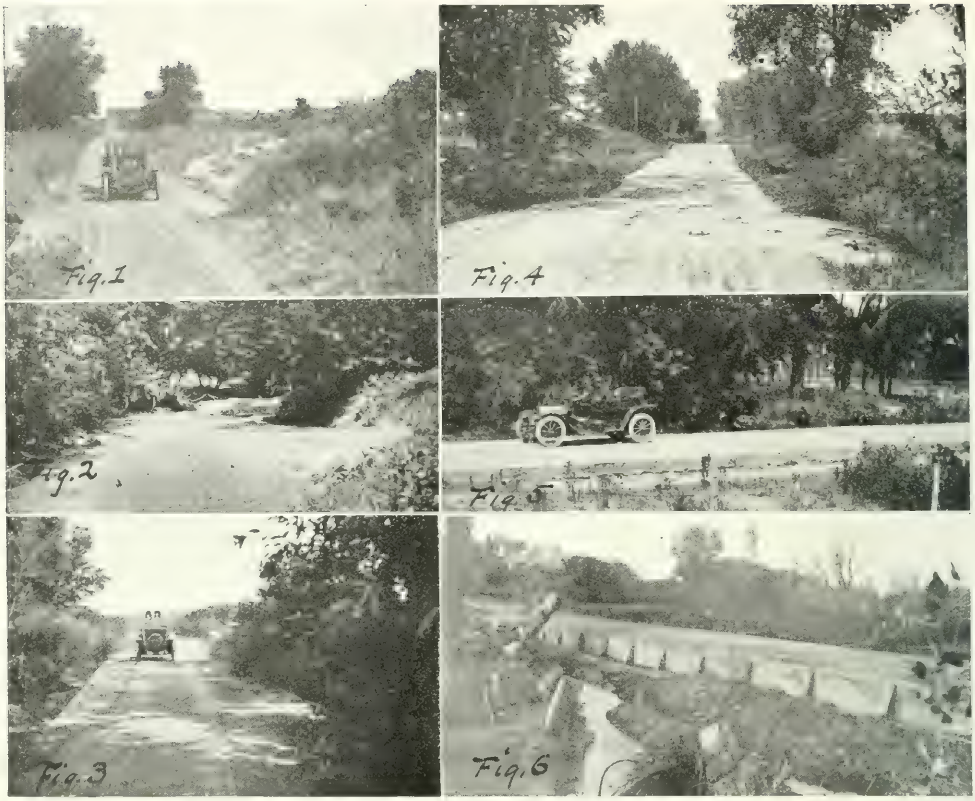
*City Engineer, Fond du Lac, Wis.

*City Engineer, Mason City, Ia.

[1] Made by American Steel & Wire Company.



Concrete Fords

Fig. 1 shows the first ford of concrete known to the author; it was while trying to extricate an automobile that had buried itself to the axle in the sand at this place in Webster County, Neb., that the idea came as to what might be accomplished with concrete. There was plenty of good aggregate and water only a few feet away. This ford illustrated has now been in use three years and there is about ½ mi. of similar work in Webster County. There has never been any expense for repairs on these fords. Once a flood deposited too much sand on one of them and a few hours' work was required to scrape it off.

Fig. 2 shows a sand bed that no auto driver ever got across unassisted prior to putting in the ford.

Fig. 3—Notice that willows and tree roots, weeds, etc., have grown in close to the concrete work; this knits the soil together and in favorable places entirely prevents cutting the earth and sand away from the lower edge of the ford.

Fig. 4 is a splendid example of a 20-ft. roadway where both sand and marshy mud are negotiated. This ford was raised higher than others and an apron 3' wide was built to take the scour of overflow water on the down stream side.

Fig. 5 is a side view of the same ford.

Fig. 6 illustrates a construction which takes care of the normal flow of a live stream through a 2-ft. tube of concrete. The buttresses shown securely hold together floor, side wall, and apron. A railing is being put up on the lower side of this concrete work which will serve to guard against accidents when flood waters are running.

diately after it is laid, should be covered and protected from the sun, and as soon as it is hard enough, should be sprinkled frequently and kept wet not less than 8 days.

15—Concrete paving, where the width of roadway is more than 20' between curbs, should be reinforced with No. 7 American wire[1] to eliminate cracks or cracking.

16—A concrete pavement, after it is laid, should be protected and the traffic kept off for at least 3 weeks so as to give it a chance thoroughly to harden.

17—To obtain first-class results in the construction of concrete streets every detail as heretofore described must be followed.

The methods described, I have followed in the construction of 200,000 sq. yds. of concrete paving and the results speak for themselves.

The Construction of Concrete Fords

BY F. A. GOOD*

Throughout a great section of country between the Mississippi river and the Rocky mountains all sorts of waterways, and the continuing of highways over them, makes necessary the expenditure of great sums of money.

The short-lived piling bridge gives way to the steel spans, and these are in turn being replaced by concrete structures whose permanence and flood-resisting qualities are now well established.

In this territory are many shallow sand bottomed waterways which, except for the drainage of water after an unusually heavy rainfall, are absolutely dry the year around, and there are probably more creeks christened "Dry" than all others combined.

This article is not intended in any way to disparage the erection of concrete bridges and the writer is actively engaged in their construction, but there is no excuse for building a bridge at a site where another form of crossing—a concrete ford—at less expense is as good or better.

The fording of a creek or river implies the use of the natural bottom as a roadway.

This crossing at a ford when the water is a turbulent flood is fraught with danger, largely through the *certainty* of finding an *uncertain* bottom, nevertheless there are advantages in crossing a sandy bottomed, running river or creek which are lost when we attempt crossing any of the thousands of dry creek beds which have not been bridged over. The loose, shifting nature of the dry sand bed makes it impossible to haul heavy loads over its surface, the wheels sinking in, to a considerable depth, and the horses floundering through on an unstable footing—the size of the load always limited by what can be pulled through the sand and not by the hills en route.

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[1] American Steel & Wire Co., Chicago

*Cowles, Neb.

Now, while these dry creek beds offer obstacles to the hauling of loads by horses the obstacle offered to an automobile is even more serious. When an auto traveling at a fair rate of speed strikes a bed of loose sand it becomes almost unsteerable and many accidents have occurred both to automobiles and motorcycles through this cause.

The seriousness of these sand beds is increased by the fact that one must drive his car into the sand with enough speed so that he may be carried across and up the opposite side without stalling his engines, for to stop usually means getting a team to haul the machine out.

Wet sand as found under running water usually makes a good wheel base, and were it not for the uncertainty of the hidden bottom it is to be preferred to the dry sand.

We do not advise a ford as herein described if the banks were high, but there are thousands of places where excellent crossings may be built of concrete and require a minimum of upkeep.

Construction

In building concrete fords it is probable that any system of a good concrete road construction would be equally effective, always taking proper precautions that water is not to be allowed to undercut the concrete work.

We believe that the best practice for one having no experience with roads of concrete would be to lay the concrete in blocks of not more than 100 sq. ft. in each section—we usually put in our reinforcing so it will allow us to cut each block 8′ x 8′. We have used triangular mesh but think that equally good results may be obtained with ⅜-in. twisted bars laid so that a space of not more than 4 sq. ft. is left between rods. The reinforcing should be placed on top of a light layer of concrete and the remainder of a 6-in. thickness placed on top and well tamped, the concrete to be of such consistency that water will come to the surface when tamping is vigorously done. A mixture of 1:6 where sand is gravely and clean makes a good base and a 1:2 mix on top left roughened by a broom or corrugated roller, makes a surface that supplies a hold for horses and automobiles.

We have never noticed any appreciable wear on these roadways.

In construction, we usually use two by sixes for side forms and drag guides. These we stake securely, being careful to make top of form near the exact level with sand bed of creek. After the sand has been taken out from between the forms so an even thickness of six inches will be maintained we dig (immediately before placing concrete) a trench in the sand just inside the staked forms, using a tiling spade and trying to get a little more depth on the down stream side, which is much more liable to wash. Although the middle of the ford is level we incline the ends up the adjoining banks, if there are any, and we always carry our baffle wall across the ends for protection the same as at the sides.

The dirt is graded down over a concrete ford and there is no bump experienced in getting on or off the ends.

Cost

We have found that these fords may be built with a reasonable profit at a price of about $2.50 to $3.00 per lin. ft. for plain work 16′ wide.[2]

Where circumstances necessitate apron construction or a tube for a live stream or guard rails the cost is of course greater.

If someone will devise a means of injecting grout into sand, or some form of gun that will shoot wet sand full of dry cement, then the problem of building fords will be easier.

Many of the rivers in the territory to which I refer are dry on the surface during intervals of drought and the roadway can be placed without difficulty. Where the stream is small it may be diverted and then brought back to its original channel after a section of the ford is constructed.

The building in of a number of concrete tubes will enable a ford to take care of the normal flow of the stream without being inundated itself. Accompanying illustrations show various concrete fords.

Horses Not Injured by Concrete Roads

While inspecting a concrete road near Phillipsburg, N. J., Secretary Wilson, Assistant Secretary Ferguson, and W. A. McIntyre, of the Association of American Portland Cement manufacturers, met a veterinary surgeon who chanced to drive that way. He pulled up voluntarily to get the opinion of the Association engineers as to the value of the road, having no knowledge of their identity. An exchange of views developed the fact that the veterinary was a concrete road enthusiast. He is convinced that concrete does not injure horses. On the contrary, he believes they are a positive benefit to them owing to the flat crown and entire confidence with which the horse travels on concrete. The alleged injurious pounding of hoofs and strain upon muscles and tendons is, he said, all a myth. He is convinced that the ordinary macadam road, with its projecting stones, is a far greater menace to the feet of a horse than is concrete, even though macadam may have a little more resiliency. The latter is so slight as to be more than counterbalanced by the even surface of a concrete road. The foot of a horse has its tender parts and a foot-sore animal driven by the veterinary always shows relief and more willingness to travel the moment the concrete road is reached.

Has Faith in Concrete Roads

Automobile interests have on several occasions expressed their practical appreciation of concrete roads. A recent illustration is found in Detroit, Mich., where James Couzens, secretary and treasurer of the Ford Motor Co., purchased $250,000 worth of bonds so that the concrete road construction in the county would not be held up for a year on account of lack of funds. The Chicago *Evening Post* printed the following: "Wayne county voted several years ago to bond the county for $2,000,000 with which to construct good roads and as a result some of the finest roads in the world have been built radiating from Detroit. This spring there remained unissued $250,000 in bonds, the proceeds of which were to be used in finishing up the work. But as the bonds pay only 4 per cent and investors were looking for a larger return the commissioners found it impossible to dispose of the bonds through the ordinary channels. When the commission was about to give up work because of a lack of funds, Mr. Couzens, who, in addition to his activity in the Ford Co., is president of the Detroit Board of Commerce, stepped in and took the entire issue to assure the completion of the road work this year." This is significant indication of the satisfaction which the concrete roads of Wayne County are giving.

The Milwaukee river on the Port Washington road, near Madison, Wis., will be spanned by a concrete bridge which has been designed by M. W. Torkelson, bridge engineer, Wisconsin Highway Commission, Madison. This bridge will consist of four concrete arch spans of 65′. The width of the driveway will be 40′ and there will be two 10′ cement sidewalks. It is the intention to use a brick pavement on a concrete base. The approximate quantities in the arch proper, not including any concrete in sidewalks or on the base of the bridge, is 1,200 cu. yds. and 115 tons of steel reinforcement.

The Concrete-Steel Engrg. Co., N. Y. C., has recently been engaged to design the new concrete arch bridge to be erected over the West Canada Creek at Herkimer, N. Y. The structure will consist of four arches, and will have a total length of approximately 650 ft. This bridge will replace a steel bridge that was destroyed in the spring flood.

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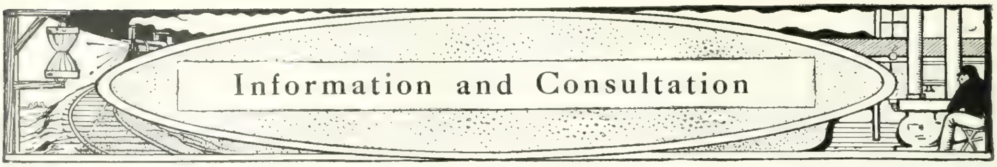
[2] [illegible]



Information and Consultation

We learn best by doing. This department is a place of exchange between those men who know from specialized experience and those men who want to know. The Discussions are specific and direct. In the following pages the topical heads show the many lines of activity in the concrete field which are covered. Questions and Discussions are cordially invited

275. Structural Steel Cores for Concrete Buildings

"In some of the more recent work structural steel shapes are used extensively for column cores.

In our modern city buildings where the floor space on the first floors is valuable, the steel column undoubtedly presents a very economical and efficient construction. We would like to know (a) What is the best steel shape to use for a column and (b) What is the best connection between the reinforced concrete girder and the steel column to take care of the excessive shear?

275. Discussion by Emile G. Perrott*

Relative to steel columns in modern city buildings in connection with reinforced concrete floors, it has been our practice to use columns which would best suit the particular case and need. The common form is known as a star-shaped column built up with four angles with plates. This shape permits of making the diameter of the column as small as possible.

We have also adopted several other types of columns, the latest of which we used in the extension to cabinet factory of Victor Talking Machine Co., Camden, N. J. This column is designed to act not only as a structural steel core, but also to permit of a higher unit value on the enclosed concrete. The stress on the concrete inside the column we figure at 1,000 lbs. per sq. in., and the unit stress on the steel, 12,000 lbs. In other columns, no matter what their shape, we provide shelf angles and brackets just under the beam and girder rods, designed heavy enough to take all the vertical shear which will come on the bracket from the beams and girders. This is the only safe way to design a combination concrete and steel column. The connection between girders is made by placing bent bars around the columns near the top of the girders or beams located in the floor slab, extending 3 ft. or 4 ft. beyond the center line of the column. These rods vary in size according to the size of the girder and the method of calculating the girder, whether it was restrained or figured as a simple beam.

* * *

286. Concrete Floors in Soap Factories

"Do the fats and alkalies used in manufacturing soap have any effect on concrete wearing surfaces?"

286. Discussion by R. A. Plumb.*

We are of the opinion that there is very little opportunity for any uneasiness on the subject of serious disintegration of concrete by the action of alkalies in the form of hydroxyl. In the process of setting, Portland cement develops a large content of calcium hydroxide, and as this constituent is homologous in general properties with other hydroxyl salts, there should be very little opportunity for any serious reaction, unless the caustic solutions were so concentrated as to be effective upon the silicates present in the hardened concrete.

It is our opinion that there would be more difficulty in a soap plant from the action of the various fats, particularly animal fats such as tallow, in affecting the concrete, than from the caustic solutions. If there is opportunity afforded for the absorption of animal fat into the concrete, there will invariably be more or less saponification by the action of the calcium hydroxide present in the concrete, tending to form calcium salts which require larger volume to accommodate them than originally occupied by the calcium hydroxide, and as a result there is manifest an internal disruptive force.

To our knowledge, there is very little opportunity for tallow in soap factories to come in contact with the floor in any appreciable or excessive quantity, as it is received in secure packages, and the saponification in the manufacture of soap is confined quite entirely to steel kettles, and there would be no reason why concrete floors could not be used most successfully in general soap plant construction.

* * *

305. Colored Mortar For Stucco and Plaster

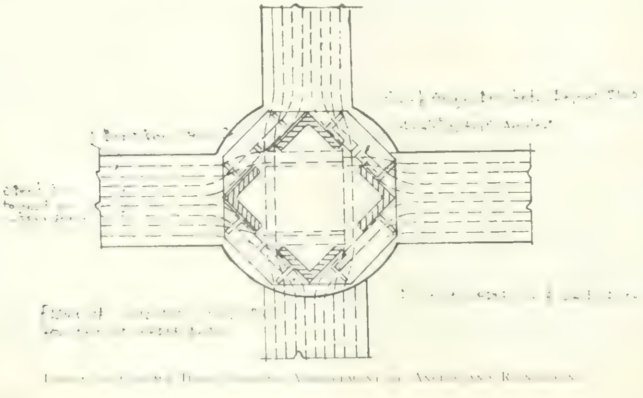
"As a low-cost interior finish, would it be practical to mix one of these prepared 'cold water' paints with the mortar? Could mortar colors be used? Would this be applicable to stucco?"

305. Discussion by H. E. Hollister*

I have noticed a request for information and several comments on the use of cement and lime when colored, as a wall plaster. I have recently designed and erected a plant for the manufacture of just such an article and a few suggestions may be in order.

In the first place, what is ordinarily known as prepared cold water paint would not be suitable for use in coloring wall plaster or mortar.

In asking the above question it was not



[illegible] Arrangement of Angles and Rods stated whether the writer wished to mix his mortar by hand or mechanically but is assumed he intended to do it by hand. The use of colored mortars is not "a lost art" as some one puts it, or if it was the secret has been rediscovered. The main requirement is care. I have found it is almost impossible to mix up either a colored lime or cement mortar by hand and get satisfactory results, but by mixing all materials together in a mechanical mixer it is possible to produce almost any color or shade of a color. It is also possible to mix batches, months apart and when applied to the wall, with proper care, either as a patch or a continuation of the work, no difference of color can be seen.

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*[illegible]

*Gen. Dir., Trus Con Laboratories, Detroit

*Engr., Cambridge, Mass.

This applies mainly to stucco work. One contractor tried it for interior use with good success but found the ordinary hard finish white wall with a coat of prepared cold water paint cheaper.

Almost any metallic or mineral dry color can be used to color mortar. Only by experiment and experience can the color of the finished dry wall be judged when preparing the colored mortar. Some colors fade when exposed to sun and light, but most of them hold. This also applies to painted walls.

A large portion of the results in this work depend on the plasterer, as heavy or continuous troweling will darken and streak the plaster and carelessness will spoil the work. For stucco work colored mortar is more satisfactory as it can be chipped or scratched without showing a different color as is the case with painted work, moreover it is permanent, which cannot be said of paint.

Finally, I would not advise mixing by hand as it is almost impossible to get a desired color and match batches. For inside work colored mortar may be better in some ways and for special cases but it is not the cheapest way for ordinary buildings.

As most prepared cold water paints are made up with size or glue, in addition to the color, they are more harmful than useful in either lime or cement mortar.

* * *

309. Concrete Bridges to Withstand Flood, and Their Comparative Cost

The flood which occurred here recently has demonstrated the fact that steel bridge construction with stone abutments will not stand the test of permanency. Our tax payers consequently are beginning to feel the need of some education along the lines of bridge construction, as our county lost 30 bridges of steel construction during the recent floods.

"I have been asked to furnish some reliable data on this subject for the benefit of some of our large tax payers. Having this task on my hands, would you kindly furnish me with facts in regard to the comparative cost of reinforced concrete bridge construction as against steel construction with stone abutments."

309. Discussion by Jno. B. Leonard*

The element of cost is naturally of first importance to the prospective builder, and is worthy of careful consideration. In the first place, it is generally understood that a concrete bridge is more costly than a steel bridge. This statement needs explanation in order to convey the truth. It so happens that a concrete bridge may be cheaper than a steel one, depending entirely upon the live or moving load. For example, it is cheaper to build a reinforced concrete bridge, to carry locomotive and train loads, than it is to build a steel bridge for the same loads. On the other hand, a light highway bridge of steel with timber floor is cheaper than a concrete one. Concrete bridges are so heavy in themselves that the addition of a heavy live load does not materially alter their design. With the steel bridge, the live load is the all important factor, a heavy live load necessitating a very much heavier structure, as well as more costly. Concrete bridges designed to carry locomotive loads are at least 15% cheaper than steel bridges designed for the same loading.

The only type of steel highway bridge that is cheaper than a concrete bridge is that with a timber floor. Timber floors wear rapidly and must be replaced about once in three years, depending, of course, on the traffic. Under the usual conditions, if a steel bridge be built with a solid concrete floor to avoid the replacing of the timber, the cost of the structure will equal that of a concrete bridge.

Maintenance

It is a well-known fact that all steel bridges must be painted periodically in order to preserve them. It is equally well known that after 40 years or 50 years at the most, the steel has deteriorated to such an extent as to make replacement of the structure a necessity. It must be borne in mind, also, that county bridges will not last as long as railroad bridges, because the former are not given the same care as the latter. It may be seen, therefore, that steel bridges require maintenance, and that further, they have a limited existence. Concrete bridges require absolutely no maintenance, and the effect of age is to strengthen rather than weaken them.

Ultimate Cost

From the foregoing, it is manifestly impossible to set a definite ratio of cost between a concrete and a steel bridge. Cost is always a question of locality, of availability of materials, and of the foundations, all of which vary in each case. Steel bridges are sometimes, in fact often, built on cylinder piers, which cannot compare as supports with the solid piers used for concrete bridges. Assuming, however, that a concrete highway structure for a given locality can be built for $100,000, we may safely say that, ordinarily, a steel bridge with timber floor can be built for $85,000, and assume that its life, with proper maintenance is fifty years. On this basis the annual charge for the steel bridge would be about as follows:

Average annual charge for repainting, assuming the bridge is painted once in 5 years at a cost of $4,000	$ 800.00
Average annual charge for renewing floor	400.00
Annual interest charge at 4% on the investment	3,400.00
Annual sinking fund for renewal at end of 50 years at 4%, compounded	356.75
Total annual charge	$4,956.75

The only charge against the concrete bridge is the annual interest on the investment, which, at 4%, amounts to $4,000, or a net saving of $956.75 per year in favor of the concrete bridge.

In addition to the advantage shown in the preceeding, in favor of the concrete bridge, there is the artistic difference between the two, for which no monetary value may be assigned. The artistic side of bridge building has been given less attention than its importance warrants for concrete lends itself beautifully to this phase of design.

* * *

317. Preserving Wood in Concrete

"Several years ago the writer was in charge of concrete construction; the walls were poured concrete and the window frames, of course, were set in. It is field practice in this sort of work to fit a strip along the window frame to tie it into the walls, and it occurs to me that it might be an additional precaution if specifications required that the window frames be coated with some adhesive, preservative waterproofing. This would serve two purposes; it would not only keep water out of the wood and preserve it, but it would also help to make a tighter bond between the window frame and the concrete. Is this a practical suggestion?"

317. Discussion by A. L. Fridstein*

This question brings out an interesting and obviously important point in concrete construction. It is our experience that a compound which will have desirable action on wood, will not form a bond with concrete. In other words, the matter of a paint, or coating for the wood, which will, at the same time, form a bond with the concrete would form a difficult problem.

Although the writer has had no personal experience with exactly the conditions pointed out, we have found that wood in concrete construction can be made to last indefinitely by treating it with creosote, in a competent manner. Creosoted wood will adhere more firmly to the concrete than untreated timber and is indefinitely free from dry-rot and decomposition and excessive contraction. In above-ground construction, where green wood or wet wood is embedded in concrete and subsequently subjected to prolonged high temperatures, the wood tends to shrink and tear itself away from the concrete. It is practically prevented by the creosoting process.

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*Cons. Bridge Engineer.

*Waterproof Engrg. [illegible]

* * *

320. Concrete In House Construction and Limestone Aggregate

"We are considering the advisability of erecting a number of concrete houses for laboring men and would like your advice on the following:

> *"First—Would you consider a monolithic or solid poured concrete house too damp for comfort and health?*
>
> *"Second—We have a limestone ledge very near the territory we should undertake to improve with such houses, which could be crushed to furnish the aggregate for the concrete, but we desire to know to what extent, if at all, the fine powdered limestone dust might be used to displace the requirements for sand in concrete work. Could you furnish us a formula for the use of this dust in a mix suitable for house building?"*

320. Discussion by M. D. Morrill*

We have planned or built several hundred of such houses in various parts of the country, and if reasonable care is taken in construction, there should be no difficulty from dampness. In fact we have never received a complaint in this connection. Reinforced concrete being of solid stone, however, does not make so warm a house in winter as where some sort of insulation is utilized. Solid wall houses are, however, giving satisfaction near Washington, D. C. We have some 25 to 30 in this vicinity, and on many of these the plastering has been altogether omitted; the walls only being floated up with sand and a cement finish, painted with a cement wash outside and water paint inside.

We judge that it would be possible to utilize the limestone which you mention, without sand. One suggestion would be to crush this limestone to pass through a ¾" screen, using dust and all; this being mixed with cement and hydrated lime for waterproofing qualities and density; this mixture to be poured into the forms and fairly good sized stones of irregular shape, 5" or 6" in diameter could be grouted into the mixture. These stones are forced away from the face of the wall by a spade so they are entirely within the concrete and leave a smooth finish. For buildings of this sort, the one-story cottage of the bungalow order with a low pitch roof would be preferable, covered with a Barrett specification slag. This gives a thoroughly permanent, fireproof roof and is inexpensive.

323. Keeping Track of Centering Units

"In large reinforced concrete buildings, where the form units have to be framed up ahead of time, what is a good method of numbering or lettering the forms to indicate their position in the work? Would a system of co-ordinating the columns, or panels, much as a map is co-ordinated, be of value? Do you use stencil or free-hand to letter the form units?"

323. Discussion by C. H. McAllister*

In regard to numbering or lettering form units, we have always marked our columns and panels in such a way that they could be easily assembled, giving the erecting foreman a chart or sketch to enable him to handle his work economically and expeditiously. We used both letters and numbers, the first letter indicating the kind of form, *B* for beam, *C* for column, *P* for panels, etc., the second letter indicating the location of section; as *A* indicating the rows of forms from wall to first row of columns inclusive; *B* indicating rows of forms from first set to second set of columns including the second set, etc.

The numbers indicate the position of the piece in the given row. For example—form marked *"CD* 4" would indicate a column form in the fourth row, and the 4th from that end, from which the numbers are supposed to start.

The wall forms are marked separately, using the letters indicating the points of the compass to give location of the wall and the letter W to indicate a wall form, as *W. E.* 4 meaning "wall—east side 4th panel."

This system works well under all conditions and can be elaborated so that walling timbers and collars for column forms can also be marked and identified.

We did all our marking free-hand, but the stencil is the neatest and quickest, and when placed on the forms at given points, gives the appearance of a businesslike method.

* * *

325. Cinder Foundation in Sidewalk Construction

"We would be glad to hear from authoritative sources some expressions of opinion relative to comparative merits of concrete sidewalks with and without drainage foundation, using as a basis for comparison, a 4-in. thick slab of concrete laid on a cinder cushion 8" in thickness, or a 4-in. thick slab of concrete laid on a solid dirt bottom, without any cinders or other provision for drainage. Our own experience has been that the latter method is equally as good as the former, if not a shade better, other things being equal as to material and workmanship, but we should like some expressions from engineers and others in the trade as to which of the methods, if any, is either considered standard, or tending to become so.

"In this connection, we should like to know whether or not it is usual in the case of the cinder foundation being required, to demand that the cinders be passed through a ¼-in. screen, assuming that the cinders are a good grade of factory cinders, with the usual amount of fine material, but free from waste or rubbish. We have been in the habit of using the cinders as they come to us, but we are now asked to screen them through a ¼-in. screen, on the engineer's interpretation of the clause 'clean steam cinders' used in the specifications.

"Is the specification referred to not unusually strict, and arbitrary in general, and if required to be lived up to in its entirety, would it not make the cost of sidewalks laid in strict conformity with it a very expensive, not to say an almost prohibitive, job?

"We should be obliged for your opinion relative to the following terms from the sidewalk ordinance under which we are now working:

'clean steam cinders'
'clean, sharp, screened sand' (used in the concrete)
'covering and keeping moist for three days'

"We are trying to have a change made in the specifications which will allow of good work for less money than is entailed in laying the sidewalks strictly according to sample specification and your good advices, and those of correspondents will be appreciated."

325. Discussion by Kenyon Riddle*

We have a soil here which drains well and has the desired elements for good bearing power. We do not therefore require a sub-base in either sidewalk or combined curb and gutter work. At first I thought it would be necessary in the curb and gutter, but last year we laid 35,000 lin. ft. and only tamped the soil thoroughly before laying the concrete. At present there are no signs of settlement.

I should think if it were considered necessary to use a cinder base in sidewalk work that since this base was to be 8" in thickness that the maximum size could be greater than ¼", without any question. 4" or 5" would be a good thickness for this sub-base with a maximum thickness of 4" for the cinders.

I would interpret clean steam cinders to mean those made at such places as power plants or any other place where steam is generated. These are preferred to household ashes, since they are burned so much more rapidly in the larger fires and are fused. This fusing eliminates the finer materials, which are difficult to tamp and make solid. The cleaning may be meant to refer to wetting down cinders when they are hot, this process causes the cinders to form clinkers more completely.

The clause in the specification for sand should read "clean, sharp sand—screened to meet certain standard requirements, as deemed necessary by the engineer."

Covering and keeping moist for three

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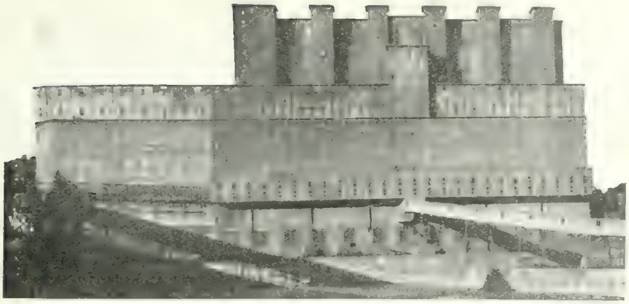
*Read & Morrill, Brooklyn, N. Y.

*Constructing Engr., John F. Casey Co., Pittsburgh

*City Engr., Abilene, Kas.



A Reinforced Concrete Elevator Completed for the Harbour Commissioners of Montreal by the John S. Metcalf Co., Montreal. The Main Elevator is 220′ 9″ High

days is essential during certain weather conditions, such as real hot, dry days. The engineer should watch the setting of the concrete and use his own judgment about wetting and covering. However, I think it quite important to guard against concrete work being starved of sufficient moisture to allow the cement to properly crystallize.

* * *

327. The Highest Concrete Building

"What is the highest concrete building in the country?"

327. Discussion by R. P. Durham*

Referring to the discussion of this question on p. 76 of the August issue, we presume that this means buildings within the U. S. On this basis the information given by Mr. Boynton in the issue referred to is undoubtedly correct. There is however, in Canada, a higher concrete building than any of those mentioned. We have recently completed for the Harbour Commissioners of Montreal a reinforced concrete grain elevator, which is 220′ 9″ from base of rail to top of concrete work, or 10′ 9″ higher than the Ingalls blg. The entire structure, including first story, bins, and the cupola above the bins, is of concrete. Even in the cupola, columns, beams, walls, floors and roof are all of this material. The elevator structure is 456′ 8″ long, by 190′ wide. The cupola is a little less than 300′ long. The accompanying illustration shows this structure.

We should be interested to know whether there are any higher concrete buildings than this outside of Canada and the U. S.

* * *

333. Permanence of Concrete Silos

In talking with a [illegible] in this vicinity who is considering the construction of several silos, he has advanced the objection to concrete construction on the grounds that there is a chemical reaction between the concrete and ensilage which spoils the latter for a distance from the wall.

"He also states that he has heard that the acid in the ensilage has a deteriorating action on the concrete which will eventually cause the concrete to crumble. Can you give me any information in regard to this?"

333. Discussion by H. T. Genung*

The subject of the first paragraph of the above quotation has been brought to our attention many, many times. We have always failed to find any reasons for such objections, and our own observance of two silos here in our city which we built and which we are watching very closely, fails to disclose even the slightest tendency toward this effect. The trouble is that people have an inborn scepticism about the efficiency of concrete for silo construction. Our 'other material for silos' brothers know this scepticism exists and strive constantly to develop it. All this has a tendency to waive deep seated investigation when some adverse condition appears in a concrete silo, for the sceptical are commonly emotional,—so the verdict very often is 'concrete won't do for silos.'

We are certain that if an investigation were carried far enough, one would find that the silo in which this trouble appeared was either rough inside, out of trus in circumference, or was only a few feet high—say 30 ft. Under certain conditions any of these causes will give the effect complained of, and to the casual observer it might appear that some chemical action between the wall and ensilage took place. The facts are that something prevented even settling, or sufficient settling of the silage and settling is always least at the wall, of course. A silo badly out of a true circle frequently will impede settling—and if one doesn't get a good "settle," one will have spoiled ensilage.

The silos we mention above as being here in our city are the Emge silos which have quite a reputation. We built them ourselves, not ½″ out of a true circle. Mr. Emge had to fall back on his ensilage a couple of weeks ago as his pastures failed. We have been watching this ensilage during the past week and we cannot find a single bit of mould of any kind anywhere. This ensilage was put in last fall, fed from all winter, left and come back to this summer. Certainly if there were any chemical action going to take place, it ought to have been developed under these conditions. The silos are not plastered or brush coated inside, but are perfectly smooth. That is why there isn't any spoiled ensilage, and that is why there is no effect that can be laid to "chemical action."

These silos are 60′ high and perfect cylinders. They were filled about full last fall; tramping or no tramping, under this design and these conditions the settling is going to be perfect, for the time at which ensilage is most sensitive for settling is not when it is being cut, but a few days after it is in the silo. One can't tramp it then but the operation becomes automatic when the design is right and the construction also is right. The farmer on the farm adjoining Mr. Emge's, summer before last, lost one-third of his ensilage which was stored in a *brand new* wood silo. Most of the loss was around the silo next to the wall. The silo is 28′ high. Why did his ensilage spoil? Was there a chemical action between the wood and ensilage?

No, we consider the 'chemical action' complaint about as absurd as the 'deterioration complaint.'

The move to forestall such complaints, and to remove scepticism, at least to reduce both, is to talk, recommend, and push proper silo design and construction, and this means—*keep close to perfect circle, get a smooth wall, and build high!* Don't permit anyone to claim that ensilage cutters won't fill 75-ft. silos. When the proper design of concrete silos is arrived at, the filling process, as we have tried to explain, becomes automatic.

333. Discussion by J. [illegible]*

The following figures are an average of four tests made by one of the food chemists of the Agricultural College at Madison, Wis. These tests were made with two samples of ensilage. No. 1 was taken from next to the wall, and No. 2 was taken from the center of the silo.

	No. 1	No. 2
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Fat	.87%	.85%
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Ash	1.40%	1.64%
	[illegible]	[illegible]

From these tests it will be seen that the assumption above is inaccurate. The ensilage throughout these samples is practically alike. From these tests it will be noted also that there is a lower ash content in No. 1 than in No. 2. From this it is evident that the ensilage next to the wall is in better condition and has more nutrine in it than the ensilage in the center.

We have not had any of the farmers complain about the action of the acid in the ensilage on the walls of the silo. We have asked several parties, who have had concrete silos for two years, and they state that there is absolutely no such defects appearing on their wall. The writer has also asked the authorities at Madison whether they have ever had any complaint from farmers on account of this chemical action, and they informed him that they had never received such a complaint. If there was a possible chance of this action taking place you can rest assured that the clay tile and wood-stave silo people would use this as a strong argument. The wood staves are practically all made of woods which have a high content of rosins. If there were any truth in the chemical action theory, there certainly would be some action taking place when the acid strikes the rosin in the wood staves. The rotting of the wood stave is not due to the action of the acid and the rosin, but is due to the exterior action of the rains and the sun. The rain will absorb a certain amount of rosin each time, and then the sun comes out and will take up the moisture holding the rosin. Finally the entire amount of rosin will be absorbed and dry rot takes place in the wood.

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*Vice Pres. John S. Metcalf Co., Montreal, Can.

*Sec. Polk Genung Polk Co., Fort Branch, Ind.

*[illegible] Wis.

Several contractors who are in the silo business have written to us regarding finishes to be used on the interior wall of the silo, but we have been unable to give them information outside of using a neat mixture of cement and sand for that purpose. The only reason they use such a finish would be to close up the pores if the wall is not perfectly smooth when the forms are removed. We cannot see any reason whatever why the silo should be coated if the forms leave the walls smooth enough. We have had some contractors tell us that they used a mixture of lime and cement for such purpose. That is a very good mixture to use if you want a good chemical action to take place. The acid acting on the lime would certainly spoil the ensilage 6 ins. or more from the surface of the wall. A neat cement mixture has thus far proved to be as good as any.

333. Discussion by Joseph E. Wing*

Silage in a concrete silo that has been washed with a wash of pure cement and water, as thick as cream, to seal the pores, so that the wall can not absorb moisture from the ensilage, keeps perfectly to the last fragment.

If the wall is coated with coal tar or pitch it will be non-absorbent and will keep ensilage perfectly to the last shred. The one thing possible of harm from the concrete wall is that it is heat absorbent and may prevent as high temperature as the ensilage should attain, but in our many years' experience with the concrete silo we have never had anything but perfect silage, right against the wall.

I do think that the acids of ensilage might in time affect the concrete and that one ought as a precaution to tar or to use some preparation as asphaltum on its inner surface.

333. Discussion by Prof. J. B. Davidson*

It is a very common contention that ensilage has a very injurious effect upon the walls of a concrete silo. Our observation does not bear this out in any way. It is no doubt true that acetic acid in ensilage would have some effect upon concrete, but the effect is so small as to be considered negligible. Rain water charged with carbon dioxide is slightly solvent, but we do not worry of late in regard to the action of rain water on concrete. We have been in silos which have been filled as often as 14 times and there was no appreciable effect to be noticed.

* * *

334. Air-Slaked Lime

"I have several barrels of quick lime that has been exposed to the weather, in broken barrels for about one year. Will you kindly let me know if this material could be used as hydrated lime in outside stucco work? Proportions of mixture—lime, sand, cement 1:3:1."

334. Discussion by Lawrence Hitchcock†

Relative to the serviceability of quick lime which has been exposed to the weather for about a year, and as to its use for outside stucco work, we would say that if any of this lump quick lime is still in lump form, it is all right and it can be used for outside work. If, however, it has become a fine powder it has become what is called "air slacked," and in air slaking a large percentage of the lime returns to its original form and chemical composition as it was when it was lime stone and is useless, therefore, for purposes where lime is used.

334. Discussion by E. W. Lazell**

In my opinion, it would not be advisable to use air slaked lime for outside stucco purposes. Air slaked lime generally consists of a mixture of carbonated lime, hydrated lime and quick lime. The particles of quick lime are often so thoroughly coated with hydrate and carbonate that they are protected from the water and only slake after a considerable length of time.

It has been the writer's experience that plaster or mortar made from air slaked lime pops and pits after it has been placed upon the wall. Air slaked lime also works short, is non-plastic and has a small sand carrying capacity.

334. Discussion by S. B. Newberry*

Air-slaked lime is not considered of any value for mortar or stucco purposes. This is no doubt largely due to lime becoming converted into carbonate when exposed to air. I should think it unlikely that the weathered quicklime described could be used advantageously for any purpose other than for agricultural.

334. Discussion by Henry S. Spackman†

Quicklime which has been exposed to the weather for a year and air slaked is not available for use in stucco, or as a substitute for hydrated lime. Its only value would be for fertilizer purposes. When lime air slakes it does not turn to a hydrate, but to a carbonate, and as the hardening of lime is dependent on the recarbonating process, air slaked lime would simply act as an adulterant.

334. Discussion by C. W. Boynton**

We doubt whether the lime in the center of the barrels has become thoroughly hydrated, even after such long exposure. Since it is absolutely necessary, for the success of the work, that the mortar be free from lumps or particles of unslaked lime, we would suggest that the lime be slaked in the usual manner, straining off the liquid through a screen to remove any lumps, and subsequently use it as lime paste.

Suggestions as to Proportions

We note that it is planned to use a mixture of 1 part lime to 3 parts sand and 1 part of cement. There are several objections to such a mixture. In the first place the percentage of lime is too large and would weaken the strength of the mortar. Lime is not absolutely necessary for use in cement stucco work, but it is sometimes employed by plasterers because they say it makes the mixture "fat" and easier to work and apply. If lime is used, the amount should not exceed 10% of the amount of cement in the mixture. In the second place the mortar is too lean. Not more than 2 parts of sand should be used in the first or scratch coat and the same applies to the mixture for the second and finish coats.

One of the simplest ways of proportioning and mixing the materials is to mix the lime paste with the sand in the proportions of 1 part lime paste to 9 parts of sand (this mixture can be made up in large quantities); then mix cement and sand in the proportions of 1:1, in small batches as required for the work, and to this add 1 part of the sand-lime mortar, using sufficient water to produce the desired consistency.

* * *

335. Concrete Slabs for Filter Work

I have occasion to make some cement slabs about 18 ins. x 24 ins. sq. and as thin as possible. These should stand or-

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*Woodland Farm, Mechanicsburg, O.

*Prof. Agricultural Engrg., Iowa State College, Ames, Iowa

†Kelly Island Lime & Transport Co., Cleveland

**Chem. Engr., Portland, Ore.

*Sandusky Portland Cement Co., Bay Bridge, O.

†Pres., Henry S. Spackman Engrg. Co., Philadelphia

**Engr. in Chg. Information Bur. Univ. Portland Cement Co., Chicago *dinary handling and yet be porous enough for a filter.*

I don't want slabs thicker than ½" or ¾". I want as light, thin and strong slabs as will stand ordinary handling.

I have thought that a proportion of sawdust might make it porous enough. What information can you give me?"

335. Discussion by Peter DeLinde*

Take 1 part of fine, clean sand and 2 parts of cement; mix it together dry. Then take 4 parts of fine pulverized sawdust, soak it in water for a few hours, then mix it well together with the sand and cement. Take care not to get this mortar too thick. Then spread a thin layer, say about ½ in. thick, on the bottom of the 18-in. x 24-in. mold, then reinforce it by placing a piece of wire cloth on it and spread another thin layer of mortar on top of the wire. Press it very firmly together, leave it in the mold in a shady place for 3 or 4 days, when it will be strong enough to handle.

335. Discussion by J. D. Carey†

I would suggest that ground cork, asbestos and cement be used in parts of about 4:1:1, respectively.

If this material be mixed reasonably stiff and squeezed under a press, I believe the slabs will be as desired. Should cork be deemed too costly, fine torpedo gravel might be used, running in size from wheat to corn. Such a mixture will be more fragile than the first one. It will be heavier also.

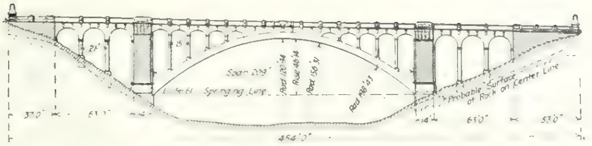

Fig. 1—Elevation of the Meadow St. Bridge, Pittsburgh

336. Long Span Concrete Bridges

"What is the longest span reinforced concrete bridge?"

336. Discussion by H. G. Tyrrell*

The Risorgimento bridge over the Tiber at Rome, with its clear span of 100 meters (328.08′) is in many ways a striking contrast to those adjoining it. The deck is 65′ 6″ wide and 47′ above low water, and it crosses the river in a single span. It is most interesting to note, that, after a lapse of more than 2,000 years, the world's record for a concrete masonry bridge is again at Rome, where the first ones originated. Pons Aemelius, which was completed B. C. 142, after undergoing numerous repairs, continued in use until 1890, when most of it was removed to make room for a new steel bridge. The most interesting features of the new Risorgimento bridge are its foundations, flat rise, hollow spandrels, uncertain action, surface treatment, and method of erection. The bridge is of cellular construction, with thin face walls, and seven interior ribs, with thin slabs at the soffit and deck. It cost $7.50 per sq. ft. of roadway surface, or about the same as the Walnut Lane bridge at Philadelphia.

The Auckland Bridge

The concrete arch bridge on the North Island at Auckland, New Zealand, has a clear span of 320′. In addition to the central span, it has several concrete girder spans of 35′ to 81′, the longer ones having open webs. The bridge is 40′ wide including the two 6-ft. sidewalks, and 147′ above the valley. Its total length is 910′, and the two main arch rings are hinged at the springs and center. The floor is paved with asphalt and the walks with cement. The two parallel arch rings supporting the spandrel columns are connected by wide reinforced concrete ties.

The Pittsburgh Bridge

The new bridge on Larimer Ave., Pittsburgh, has a clear span of 300′, the longest yet completed in America. It has a total length of 670′, and at its highest point, the deck is 115′ above the level of Washington Blvd. beneath it. It is very light and ornamental, its two arch ribs supporting the spandrel columns which are beneath the roadway. The approach corresponds in design with the bridge, having open trestle arches

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*Zion City, Ill.

†Bldg. Contractor, Cleveland

*Evanston, Ill.

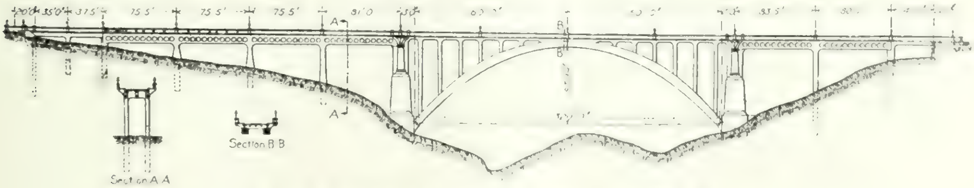

Fig. 2—Elevation of the Concrete Bridge at Auckland, N. Z.

Concrete Bridges [illegible]

[illegible]	Over	Date	Length ft.	[illegible] ft.	[illegible] ft.	[illegible]	[illegible]	Engineer
Rome, Italy	Tiber	1911	[illegible]	32.8	[illegible]	[illegible]	[illegible]	Hennebique
Langwiez, Switzerland	....	[illegible]	[illegible]	[illegible]				
[illegible]		1911	[illegible]		4	H.	170,000	Moore
Pittsburgh, Larimer Ave.	Negley Run	[illegible]	300	[illegible]		[illegible]		Wilkerson
[illegible]	[illegible]	[illegible]	281	[illegible]	[illegible]	Hy.	....	Ralston
Cleveland	Rocky River	[illegible]	[illegible]	80	[illegible]	Hy.	208,000	[illegible]
Stein-Teufen, Switzerland	Sitter	[illegible]	[illegible]	[illegible]	[illegible]	Hy.	[illegible]	[illegible]
Philadelphia, Pa.	Wissahickon	1906	[illegible]	[illegible]	[illegible]	Hy.	262,000	Quimby
Morbegno, Italy	Adda	[illegible]	230	[illegible]		....		
[illegible]	[illegible]	1904	230	42	[illegible]	Hy.	[illegible]	Morsch
[illegible]	[illegible]	1909	[illegible]	[illegible]	[illegible]	Hy.	[illegible]	Hennebique
[illegible]	[illegible]	[illegible]	211	[illegible]	[illegible]	[illegible]		
[illegible]		[illegible]	210	[illegible]	4	Hy.	[illegible]	
Pittsburgh, Pa., Meadow St.	R. R. Yards	1910	209	46	[illegible]	Hy.	[illegible]	[illegible]

terminating in comparatively small abutments. The roadway is 30′ wide, and sidewalks are supported on projecting brackets. Surfaces are finished with horizontal grooves to remove the form marks, and altogether the bridge is of the most modern design and construction.

Bridges At Spokane and Cleveland

The Monroe St. bridge at Spokane has the next longest span with a clear opening of 281′. It is of the same type as the three preceding ones at Cleveland, Stein and Philadelphia, with double slabs in the intrados, separated by a space of about 16 ft, which is bridged at the deck with the regular floor construction. Other features are its open spandrels and overhanging sidewalks, and Dutch towers at the ends to be used as public lavatories. The roadway is 50′ wide, and the total deck, including sidewalks is 71′ across. From end to end it is 791′ long. On the north side of the river, the ground is naturally suited for an arch, but on the south side, heavy abutments are carried down to 140′ below street level. These consist of four parallel walls, 4′ thick, joined by numerous cross struts and braces.

The Detroit Ave. bridge over Rocky river at Cleveland has a central span of 280′, and five approach spans of 44′ each. Its total width over railings is 60′, and its length 708′ As previously intimated, the main span consists of two separate arch rings 18′ wide at the crown, and 16′ apart. On these arches the deck is carried on cross spandrel walls, the roadway being 94′ above the water. Beneath the brick pavement, which has two lines of track for heavy suburban cars, are two subway chambers 3′ x 11′ for pipes and wires. The main arches contain no metal reinforcing except in the key blocks.

European Bridges

The Stein-Teufen bridge over the Sitter river in Switzerland, has a central arch of 259′ in the clear, and a total length on the roadway of 550′ The road is 32′ wide and 216′ above the river. At the Teufen end are two approach spans of 33′ 6″, and four at the other end, the central piers being heavily reinforced to resist unbalanced thrusts from the adjoining arches. The main rings are 21′ 6″ wide and 4′ thick at the crown, increasing in area to the springs, and reinforced with 1⅛-in. round bars 10″ to 18″ apart. The sidewalks are very narrow, only 2′ wide, and they are guarded by balustrades with openings 3′ wide, crossed by grating bars.

The reinforced concrete bridge near Morbegno, Italy, over the Adda river, has a single span of 70 m. (229.66′), with its deck carried on a system of four spandrel arches at each side of the center line. The ring is 1.5 m. (4.92′) thick at the crown and 2.2 m. (7.22′) at the springs, and is 1.5 m. (4.92′) thick at the crown, and 2.2 m. (7.22′) thick at the springs and the rise is 10 m. (32.8′).

A great increase in span length over former bridges, was made in the building of the Greunwald bridge over the Isar river at Munich in 1904, where the clear span is 230′, which was the longest span up to that time. Three steel hinges were introduced. In the following two years, bridges were built at Ulm and Kempton, Germany, with spans of 210′, the latter having three hinges. The main arch of the Gruenwald bridge was designed independent of reinforcing, though metal was afterwards added. The ring is 30″ thick at the crown, 36″ at the springs, and 48″ at the quarter points. Spandrel columns supporting the floor systems are 2 m. apart transversely, and 4 m. apart longitudinally.

The Saint Claude bridge over the Bienne in France, with a span of 65.7 m. (215.55′) was erected by the Hennebique Co., who more recently built the longest span over the Tiber at Rome. It is of cellular construction with springs at different levels, and crosses the river on a slight skew. It differs from the Risorgimento bridge at Rome by having an open archway through one of its abutments, a feature which is very evident and characteristic. The sides are enclosed with spandrel walls, and the deck is supported on transverse walls 2 m. apart. The arch has a rise of only 5.4 m. (17.72′), and the deck is 35 m. (114.83′) above water, the total length of deck being 96 m. (314.96′).

Bridges at Philadelphia and Pittsburgh

Walnut Lane in Philadelphia crosses the Wissahickon valley on a concrete bridge at a height of 147′ above the river bed. The main arch consists of two separate rings with a span of 233′, 18′ wide at the crown increasing to 21′ 6″ at the springs, the two rings being separated by a space of 16′ at the crown, as on the Luxemburg stone arch bridge. The main arch is an approximate ellipse, with a rise of 73′, and the floor system is carried on ten cross spandrel walls. The approaches embody five other arches of 53′. The road is 0′ wide and the sidewalks 10′ each, and its total over all length is 585′. It is all solid concrete without reinforcing excepting in minor parts. The exterior surface is finished rough, somewhat similar to pebble dash, but of coarser grain, with exposed stone chips not exceeding ⅜″ in size, cleaned off by washing before the cement had hardened.

The Meadow St. bridge at Pittsburgh is a fine design, and one of the largest and best in the city. The center opening is 209′, and at each side are three approach arches, making a symmetrical arrangement. In the center span are three reinforced concrete arch ribs whose curve approaches a parabola, the ribs being connected at the panels by struts, and the deck supported on spandrel beams and columns.

Proposed Structures

While the above descriptions include the longest concrete bridges which have been completed, a number of larger ones have been proposed, and in some cases detail plains prepared. A Hudson Memorial bridge at New York, elaborate designs for which were made some years ago, was to have a span of 700′ with 177-ft. rise, its total estimated cost being $3,800,000. A somewhat similar proposal was made in 1911 by Kennard Thompson, for crossing the Niagara gorge with an 800-ft. concrete span. The city of Pittsburgh, only last year contemplated a great concrete bridge 1970′ long, with a 420-ft. arch, but on account of its estimated cost of $775,000, this long span was not built. Other proposed long concrete spans are those over the Neckar river at Manheim with a span of 365′, and one proposed some years ago for carrying the New York State barge canal over a gorge near Medina, N. Y., on a span of 285′. The design with two spans of 350′ each, was offered in competition for the bridge over the Mississippi river at Fort Snelling, Minn.[1]

The Langwiez, Switzerland, Bridge

A bridge now under construction at Langwiez, Switzerland, to carry a meter gauge railway, will have a clear span of 330′, with a rise of about half its length. The two ribs are each 4′ deep at the crown and 14′ at the springs, and they are braced together at intervals with struts.

* * *

337. Silicate of Soda Paint

"Some time ago the following formula was given to us to make a paint for concrete work, claiming that it could be washed and scrubbed:

Silicate of Soda—N grade....1 gal.
Oxide of zinc ground in water..1 lb.
Flour marble enough to make the whole to the consistency of paint.

We have followed the directions and it gives a beautiful white, but it comes off and peels. We then reduced the silicate to about 20° Beaume and it does not entirely come off. When you rub it with the finger, once dried, some powder comes off.

Will you please tell me the cause of that trouble and the remedy?

If you know of any work on silicate of soda paints for concrete, will you please advise me the name of the work, that of the firm who sells it, and if possible, the price?"

337. Discussion by Henry A. Gardner*

On account of the fact that silicate of soda is soluble in water, a paint made therefrom and applied to an exterior surface of cement would not likely give service for any extended period, I would suggest that better results will be assured if an oil paint such as is mentioned in the following notes be used:

Some complaints have been noted, which point toward the fading of colored paints when applied to freshly laid cement walls. The alkaline lime present in the walls is a substance which becomes reactive in the presence of moisture, and under such conditions might prove destructive to certain paints. This difficulty, however, is easily prevented by treating the surface of all freshly laid cement work which is to be painted, with a solution of zinc sulphate crystals dissolved in water in the proportion of 3 lbs. to 1 gal. Cement surfaces thus treated may be painted with even more enduring results than wooden surfaces, and with the same types of paint that are most successfully used upon wood, namely, high-grade prepared paints made upon a lead and zinc base, preferably tinted. There may also be used the commercially prepared cement coatings which are specially designed for this purpose, and which are made upon a lead, zinc or lithopone base ground in a durable and flexible exterior vehicle. The above treatment and the use of the above named paints are to be recommended for the damp-proofing and decoration of all exterior concrete structures. This does not apply, however, to submerged masonry which is subjected to hydrostatic pressure. In the latter case special waterproofing paints made upon a bitumen base are used.

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[1] Further details of these structures may be found in "Concrete Bridges and Culverts" and "History of Bridge Engineering," by H. G. Tyrell

*Acting Director, The Inst. of Industrial Research, Washington, D. C.

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338. Preparing and Letting Bridge Contracts

"I would greatly appreciate some information as to the manner in which a contract for public highway bridge construction should be prepared, and the letting handled."

338. Discussion by A. N. Johnson*

Concerning the practice of letting public highway bridge contracts, the method followed in this office is that prescribed by the Illinois statutes, so far as lump sum bidding and bonds are concerned. The fact that the Illinois statutes, which provide that counties paying for a bridge shall not make any payment until the bridge is complete, makes a lump sum bid the most feasible method.

Lump Sum Payments

On small jobs this does not inflict any serious hardship on the contractor or extra expense on the community; but in the case of very large jobs if the contractor can receive no monthly estimates, he necessarily must have capital to carry the work to completion and the cost of doing this must be included in his bid. To this extent this method therefore costs the community perhaps somewhat more than would be the case if partial payments were made.

Bond Required

The statute also requires that the contractor shall furnish a bond for double the amount of the contract so that there is no discretion to be exercised by this department in this matter. While the statute does not require that a surety bond shall be given, I believe in general this is the better method.

Preliminary Information

It has been the practice of this department to issue a preliminary notice, which notice describes the work in sufficient detail that the contractor may gain accurate knowledge of the character of the job. Quantities are also given, together with the location of the work and what information may be at hand as to the availability of materials, the character of the roads leading from the nearest railroad stations, the general features of the bridge site, and the estimate of the cost, the object being in ordinary cases to give sufficient information that a contractor who has had any experience in the vicinity may readily furnish a mailed bid without the expense of inspection of the bridge site. Experience has proved this to be the practical outcome.

It is believed that the engineer's estimate of the cost has been of great value both to the contractors and to the public. To the contractors, as a check to them in making up their bids, and to the public as a safeguard against excessive charges which might be the case where all bidders arbitrarily raised their bids through collusion.

Attached hereto is a copy of our contract form[1] and a sample of one of our notices, which may offer some additional suggestions. It will be noted that the plans furnished show the amounts in detail of all materials required, and specific specifications regarding the quality and manner of placing in general, the endeavor being to advise the contractor precisely as to what is desired, and to leave nothing 'to the satisfaction of the engineer.' Such a procedure necessitates the careful preparation of plans and requires a survey of the bridge site, but experience has shown that the more accurately it is possible to prepare specifications and plans for a given structure based on an intimate knowledge of the work to be done, the better will be the results both in quality and ultimate economy to the public.

The usual methods that have prevailed in bridge work, not alone in Illinois but in a very large section of the country, have been so unbusinesslike and loosely conducted that the gravest irregularities have become more nearly the rule than the exception. The result was in most cases inadequately designed structures at exorbitant prices which condition will always prevail until bridge work is put in the hands of competent engineers and the work carried on in a businesslike way.

The Notice Used

A specimen of the preliminary notice follows:

Propose Highway Bridge Construction

[illegible] to be correct and is furnished for the con- [illegible] bids, but the State Highway Commission assumes no responsibility for, nor guarantees as correct, any of the statements made herein.

Advertisement
Highway Notice Public Letting of
Contract

Notice is hereby given that sealed bids will be received for the following described bridge work at the time and place indicated below.

More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Illinois.

Bids will be received up to 1:00 o'clock P. M., May 20, 1913, at the Court House, Mt. Carroll, Illinois, for the construction of three reinforced concrete bridges to be built in Cherry Grove Township, Carroll County. Albert Lindsay, Town Clerk, R. F. D. No. 3, Lanark, Illinois.

Zier, Leonard and Myers Bridges:—Spans, 30', 30' and 22'; roadways, 16'; height, 15', 15" and 16'. Estimated total concrete, 92.8 cu. yds., 93.2 cu. yds. and 87.8 cu. yds.; reinforcing steel, 11,180 lbs., 11,220 lbs. and 8,150 lbs.

Nearest railroad stations, Lanark, about 6½ miles; Shannon, about 5 miles and Lanark about 3 miles.

Gravel available in creek bed at 25 cts.; at pit, about 3 miles from Zier bridge, must be washed and sand added. It is reported that gravel may be had F. O. B. cars at Lanark or Shannon for $1.40 per cu. yd.

Present bridges wood, 18-ft. span, wood trestle, 40' long, and wood, 14-ft. span. Excavation gravel, average depth about 14 ft., 5 ft., and 12 ft., to be carried about 3½ ft., 4 ft. and 4 ft. below stream bed.

Engineer's estimate for the 3 bridges, $4,250.00.

Bids will be received on basis of completing August 1st, and also on basis of completing September 30, 1913.

Springfield, May 3, 1913.

[Note: Mr. Johnson, in a recent letter to the editors, states that the new Illinois Road Law materially changes the method of letting contracts. The above general suggestion, however, concerning the practice of letting contracts, will still hold although it should be understood that these notes were written prior to the adoption of the new law.

It will be noted that the present statute requirements are considerably changed in the new law in that the county superintendent is required to pass upon bridge plans for county and township work, while for state work, and county bridges alone, such plans must receive the approval of this department and monies cannot be paid for such work until approved by the county superintendent. The new law was approved June 27, 1913—Editors.]

Auto Testing Track of Concrete

After using a concrete testing track ¼ mi. long, 18' wide and 8" thick since October, 1910, E. Grunewald, supt., Moline Automobile Co., East Moline, Ill., writes Concrete-Cement Age:

"We feel that it has been an excellent investment as we are able to test chassis at any time without any interference due to road conditions. As the track is of reinforced concrete and only automobile traffic is allowed on it, the wear is inappreciable." Mr. Grunewald estimates that the track is circled 1,200 times each day.

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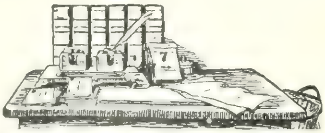
*Engineer, State of Illinois Highway Commission, Springfield, Ill.

[1] This contract form [illegible] with Mr. Johnson's [illegible]



Correspondence

South America through the eyes of a concrete engineer might well be the title of the letter from Mr. Wagner; another letter records the completion of a concrete chimney on the Pacific coast which has been described in a past issue; a steel construction tower withstood a hurricane that wrecked everything else in the vicinity; correspondence this month brings interesting information from many sources.

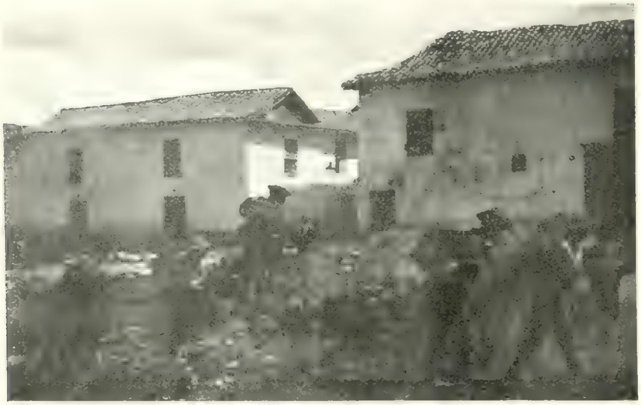


Fig. 1—Making "Dobe" Brick in the Streets of Cuzco, Peru

Construction Conditions in South America

In my trip through South America last winter, which consisted of the complete circuit, down the east coast to Buenos Aires, across the Andes to Chile, and back by way of Panama and Jamaica, I paid special attention to the methods of construction, and more particularly to the use that is being made of cement and concrete.

The Laboring Class

In South America, more particularly in the larger cities of Brazil and Argentine, while the laboring classes receive lower wages than they do in this country, the employers' profits are much larger and the country seems to be markedly divided into two main classes, the very rich and the very poor. The cities show the result of this unequal division of wealth, and though the show places and show streets of Rio de Janiero and Buenos Aires are of unrivalled beauty, the side streets where the peons live, crowded together in the utmost filth, tell a different story, and it is surprising how they manage to subsist, for the price of almost everything in Brazil and Argentine is double what it is here. On the west coast the cost of living is considerably less, but wages are also lower, so that the condition of the working people is practically the same.

The living quarters of the peons all over South America are more or less the same, of the very cheapest class of construction. They consist either of adobe huts, or if of two stories, they have a wooden balloon frame, the space between the studs being filled in with adobe brick, and the whole face finished with a coat of plaster. The adobe brick are made from ordinary surface dirt, which is worked up into a thick mud, straw is then spread over the top and worked through the mass by men treading on it with bare feet. It is then put into bottomless molds of the required size, and left to dry in the sun. Fig. 1 shows the Indians in Peru making these brick on the streets of Cuzco.

Cement Stucco on Brick

The better class of buildings on the east coast are made of very rough brick covered with cement stucco, generally trowelled to a smooth finish. The architecture of the buildings is very fine, and in the use of cement plaster the South Americans are past masters. There seems to be very little discoloration, the buildings remaining clean and white, and the effect is most charming. Fig. 2 shows the Monroe Palace at Rio de Janiero, and Fig. 3, the Hall of Congress, Buenos Aires. Fig. 4 shows a side view of Hall of Congress, and gives a good idea of the brick construction and the plaster work being applied. The brick is set in projecting courses so as to produce a very good bond for the stucco.

Cost of Materials

Machine made brick in Buenos Aires cost from $15.12 to $18.90 per M. The cheapest hand made brick cost $11.75 per M. The latter are not of the standard shape, being wide and thin.

Brick walls, 13" thick, laid up with the cheapest lime costing $14.28 per ton, cost the contractor $2.00 per sq. m. (10.76 sq. ft.). The best lime costs $21. Outside plaster of a cheap grade costs 25 cts. sq. m. (21 cts. per sq. yd.); good plaster work made to imitate stone costs 84 cts. sq. m. (70 cts. per sq. yd.).

Good sand, which must be brought from Uruguay by boat, costs $2.10 per cu. m. ($1.60 per sq. yd.) at the dock, or $2.94 ($2.25 per sq. yd.) delivered, in Buenos Aires.

Imported American cement in Mar., 1913, was $3.80 per bbl. A large consignment of cement costing $1.04 F. O. B. the ship at New York cost the importer $2.94 delivered in Buenos Aires.

Lumber is brought mostly from the southern states. Spruce is the cheapest, selling for $52.40 per M. Hard pine flooring sells from $54.60 to $67.20

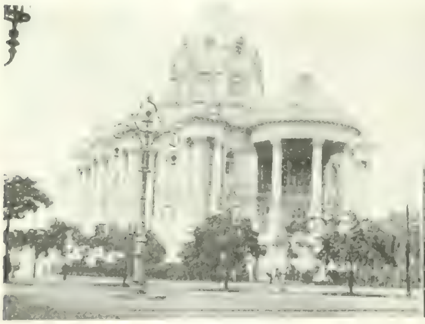


Fig. 2—The Monroe Palace at Rio Janeiro

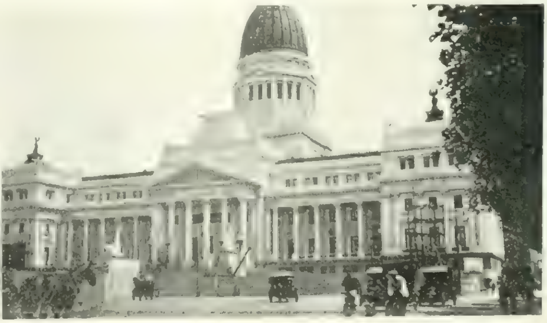


Fig. 3—The Hall of Congress, Buenos Aires

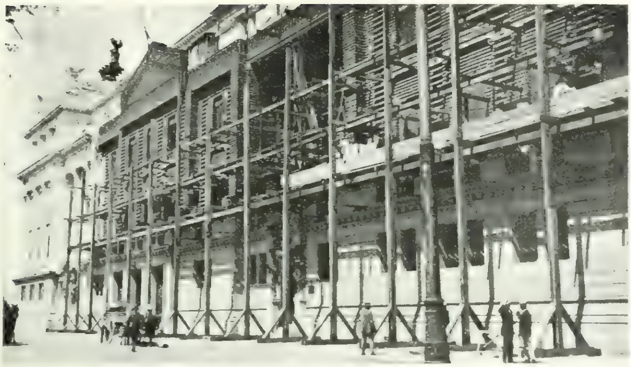


Fig. 4—A Side View of the Hall of Congress, Buenos Aires

By a close comparison of Fig. 3 and Fig. 4 it will be seen that Fig. 4 is taken from the street that goes down past the Hall of Congress at the right of Fig. 4. Note how the bricks are laid up in projecting courses to afford a good bond for the stucco

per M. The price of common labor is $1.47 to $1.68 per day.

On the west coast much more concrete is used, and in fact all the new building is being done with concrete, though of a very poor grade. The material is all right, but it is badly mixed and placed, for the pouring is not continuous, very few forms being used, and these have to be changed continually. This probably accounts, in a great measure, for the fact that concrete buildings on the west coast contain almost as much structural steel as if no concrete whatever was used, for in most instances no advantage is taken of the strength of concrete, it being used only as a filler. In many cases buildings are put up of balloon frame construction and the space between the studs filled with concrete.

Figs. 5 and 6 show a concrete church in Valparaiso, Chile, in course of construction.

Fig. 7 shows a concrete commercial building being erected, and Figs. 6 and 7 give a good idea of how the concreting is carried on in small independent sections. On the platform to the left of Fig. 6 two carpenters are at work preparing to raise the scaffold for the next section, and two men are placing and tamping the concrete, which is being pulled up by hand in a small bucket. The bucket can be seen on the inside, just below the platform. Although in some respects so far behind the times in concrete work, I was surprised to find these buildings being equipped with stairways, made in units away from the job. The rise and tread were made in one piece, "L" shaped and about 1½" thick, of what appeared to be marble chips and finely polished. Some of the steps were 8' or 10' long and curved.

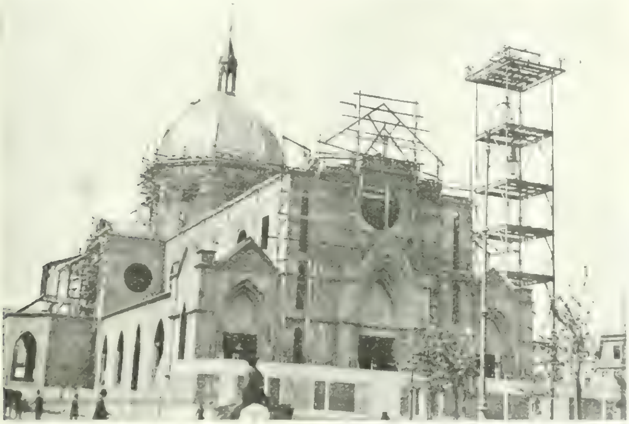


Fig. 5—Church Construction in Valparaiso, Chile

Cement is also used to a great extent for making tile for sidewalks. These tile are 8" or 10" sq., with inlaid designs.

An Ancient Church With Concrete Columns

In Valparaiso, there is a very ancient church shown in Fig. 8, the pillars of which are made of segmental concrete blocks, inlaid with white stone chips. The base plinth and pedestal are made of concrete containing different colored stones and shells to contrast with each other. The finish is rough and has an appearance of being brushed while fresh to expose the stones, but this may be due to weathering.

In Southern Peru I saw no concrete being used, the buildings other than adobe being built of stone, mostly pumice stone, which is light and easy to cut.

Jamaica

A concrete building being erected in Jamaica is shown in Fig. 9, and, as can be seen, it is of skeleton construction and quite up to date. The interesting point about this photo is the method of handling the concrete, which is all carried up to the top of the building by negro women, in buckets which they balance on their heads.

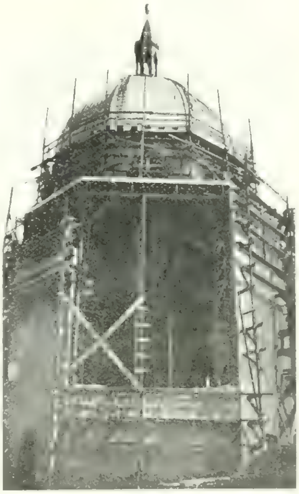


Fig. 8—D[illegible] Church [illegible] Valparaiso, Chile

The Panama Canal

Going on to Panama, the buildings, being only for temporary use, are constructed of wood, but at Colon the new Washington Hotel, of fireproof concrete construction, is a beautiful piece of work, and the new station at Ancon is another proof that for permanent buildings in the future concrete will be the material chosen.

Concrete-Cement Age readers will want to know what my impression was of the Panama canal, but I can only say that after going over the locks and viewing the mountains of concrete and the tremendous lock gates that I am at a loss for words to describe the immensity of it. Culebra Cut is less awe inspiring, for it is really so large that one loses the sense of proportion and 100-ft. cuts do not look more than 50-ft. The future water level of the canal is marked in white paint along the cut, but owing to the same optical illusion, the depth [illegible] than enough to float a good size lake boat. The famous earth slides, which start a quarter or half a mile back from the cut, do not appear to be more than a few hundred feet in length. These slides do not come suddenly, but move slowly and uniformly, a few feet each day. When I was there in May they were just starting to dam the water up at the Gatun dam, and when the water is of sufficient depth hydraulic dredges will be used to remove the balance of the earth. It is likely that the dredging will have to be continued for a number of years to take care of the slides, though there is nothing menacing about them. It is simply a case of removing enough earth from the banks to bring the slope down to the angle of repose of the material.

W. F. WAGNER

Contrg. Engr.,
Toronto, Can.

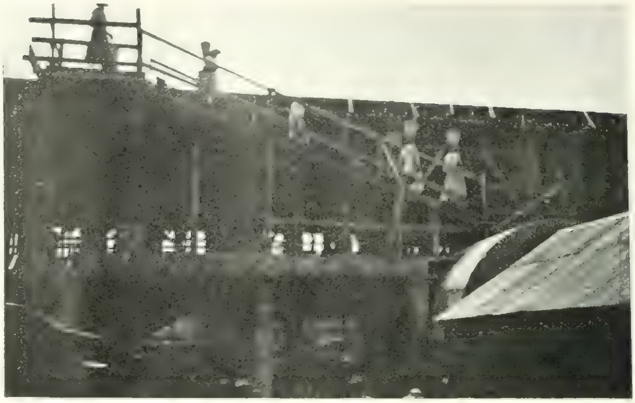


FIG. 9—CONCRETE CONSTRUCTION IN JAMAICA
The design features and the centering seem to conform with modern methods. The concrete, however, is being carried up in buckets on women's heads

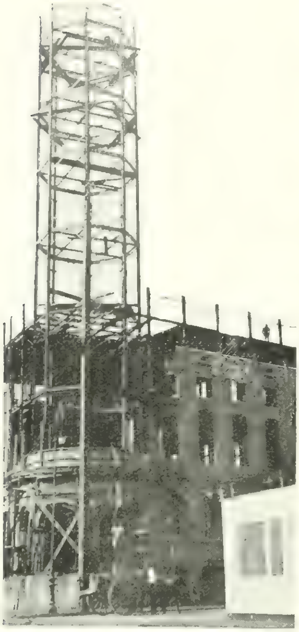


FIG. 7—BUILDING A CONCRETE COMMERCIAL BUILDING IN VALPARAISO
Note the reinforcing steel and the centering used on the second floor

FIG. 8—AN [illegible] CHURCH IN VALPARAISO, CHILE, THE COLUMNS OF WHICH ARE MADE OF [illegible] CONCRETE BLOCKS

A Reinforced Concrete Chimney in California

The accompanying photographs show the completion of the concrete stack described in previous issues.[1] The final pouring was made on May 5, and the brick lining was completed on May 24.[2] We were exceedingly fortunate in thus having prompt and satisfactory delivery made to us, for, on May 26, a very high wind accentuated a slight crumple in steel stack we were then using, about 75 ft. from its top, and the top section worked around on this crumple until it collapsed and the top section fell and bent another 40-ft. section over on the standing portion of the stack, shutting us down as suddenly and completely as if a gigantic cork had been jammed into the top of our chimney.

No other damage was done and work on the new construction was rushed to completion and the stack (concrete) formally accepted by us on May 29th, and received its first furnace gases on the 31st of May, when a wood fire was started in one of our reverberatories. From that date the heat of gases in stack was gradually increased as the other two furnaces were, in turn, warmed up previous to starting their oil fires until, on June 11th, we got everything running full. The temperature of the gases now passing through the stack is about 310° C. and we are obtaining an oversupply of draft, which we control by flue openings for the admission of cold air, thus greatly diluting the furnace gases.

THOS. B. SWIFT

Works Supt., Mountain Copper Co.,
Martinez, Cal.

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[1] P. 234 the May issue
[2] This chimney was designed and built by the General Concrete Const. Co., Chicago

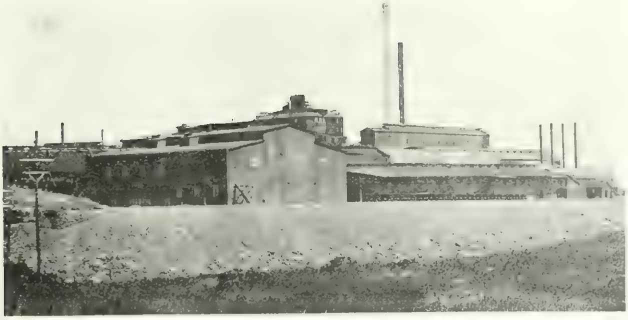


FIG. 1—THE COMPLETED CONCRETE CHIMNEY AT THE PLANT OF THE MOUNTAIN COPPER CO.

Comparative Strength of Concrete Tile Joists and Monolithic Slabs

On page 82 of the August issue an article describes tests conducted to determine the comparative efficiency of concrete tile joists and monolithic slabs. In this article the statement is made that the concrete tile slab developed 11% greater strength than the monolithic slab. In reference to this last point, editorial comment was made, pointing out that the monolithic slab was not a typical cross-section. We appreciate this editorial comment as the statement made in the article might be misleading.

What the test showed was that the concrete tile slab had 11% greater strength than monolithic construction *having the same cross-section.* The words in italics should have been added. It is a well-known fact that well-tamped concrete made from a dry mix will invariably show greater strength than concrete made by pouring with a wet mix, and one of the great advantages of concrete tile floors lies in the fact that the greater portion of the floor is composed of this quality of concrete. The test, therefore, was if anything, decidedly favorable to the monolithic construction, since the quality of the poured concrete was better than might be ordinarily expected on the job, whereas the concrete tile were representative of the product as it would ordinarily be manufactured.

Concrete tile floors are *especially adapted to long spans* on account of the great saving in dead weight, as will be seen from the fact that for the span and load used in the test, a solid slab would have to be 16" deep and would require more than twice as much concrete and 30% more steel.

A. B. WHITE

White & Co.,
Spokane, Wn.

* * *

Concrete at the Panama-Pacific Exposition

It seems to me that our Panama-Pacific International Exposition, to be held in 1915, will offer a good opportunity to hold a convention of reinforced concrete engineers, contractors, cement manufacturers, etc. Such a convention, or Congress, could be sufficiently representative to illustrate to the world the possibilities of concrete, and particularly what this country is doing along these lines.

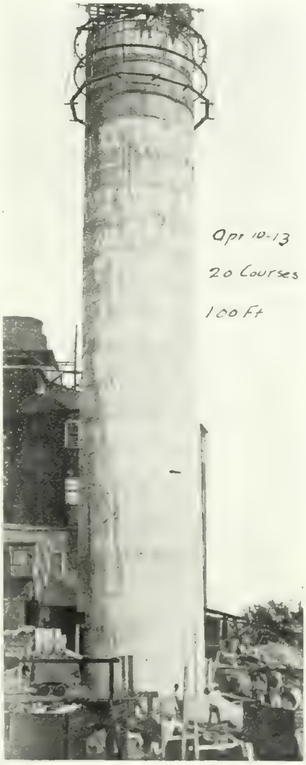
Indeed, such a convention might be made truly "international" in character, at which addresses and papers, treated in a popular way, understandable by the general public, could be given, and which would possess considerable educational value. Ocular demonstrations are easily remembered.

Drawings, and scale models of executed work in concrete, reinforced and otherwise, if exhibited, would present this form of construction interestingly and instructively to millions of people.

A discussion of this idea among your readers, and advertisers should be of interest.

G. ALEXANDER WRIGHT

Cons. Arch.,
San Francisco



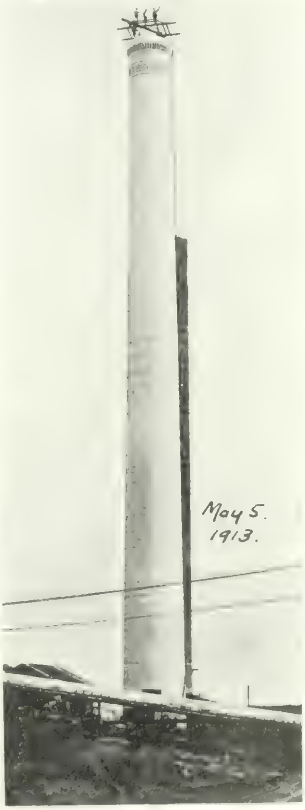
Apr 10-13
20 Courses
100 Ft

FIG. 2—A DETAIL VIEW SHOWING THE CONSTRUCTION WORK AT THE PLANT OF THE MOUNTAIN COPPER CO.
This view was taken April 10, 1913.

* * *

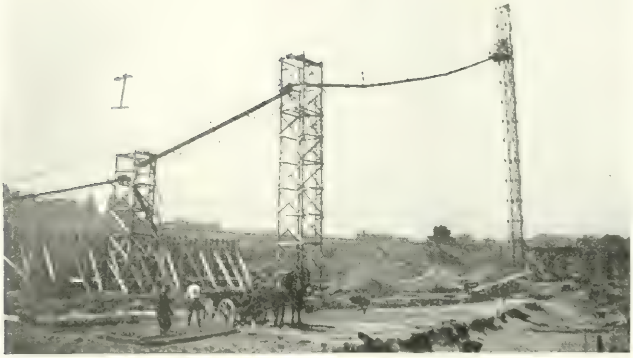
Stability of Steel Construction Towers

The city of Youngstown, Ohio, is building a filtration plant, in which concrete figures very extensively as a construction material. The contractors for this work are the W. M. Henderson Co., and part of their plant is a Lakewood[1] steel hoist tower 105' in height. From this tower the concrete is carried about 225 ft. in steel chutes supported by two intermediate timber towers as shown in the accompanying illustration. One of



May 5.
1913.

FIG. 3—THE [illegible] CONCRETE CHIMNEY [illegible]
MAY 5, 1913
[illegible]



Work on the Youngstown, O., Filtration Plant Showing the Use of Steel and Timber Construction Towers

these towers is about 60 ft. in height and 120 ft. from the steel tower. The other is 50 ft. high and about 50 ft. farther from the steel tower.

A violent wind storm passed over Youngstown in the latter part of July, blowing off the roof of a box car on a siding, tearing loose the cab of a steam engine, uprooting trees, tearing the roof off buildings, destroying trolley and telephone wires, overturning several shanties, and leveling to the ground both of the above lumber towers.

With the destruction of the two timber towers, the entire line of chute hung from an overhead cable attached to the top of the steel tower, and anchored to a dead-man at a point beyond the timber towers, and one 48-ft. section, supported from one end only, swung from the cable. This, of course, added to the tremendous strain on the steel tower, which was guyed by steel cables securely anchored to dead-men.

Mr. Henderson watched the progress of the storm from a nearby building, and stated that the steel tower swayed to and fro slightly, and that he thought it utterly impossible for it to ever survive, but to his amazement, when the cyclone had subsided, the steel tower with the line of chute hanging to it remained uninjured and ready for work.

Mr. Henderson stated also that this steel tower saved on this one job at least $1,000. As an illustration of the stability of steel towers in a wind storm, this instance is very interesting indeed.

Cleveland, O. L. R. Wilson

The Organization committee of the Lincoln Highway Association, with headquarters in Detroit, Mich., has issued a folder outlining the aims and purposes of the organization. In its statement of objects is the following: "Immediately to promote and procure the establishment of a continuous improved highway from the Atlantic to the Pacific, open to lawful traffic of all description without toll; and to be of concrete wherever practicable."

[illegible]

German Regulations For Reinforced Concrete

Discussing the new Prussian regulations for reinforced concrete, *Concrete and Constructional Engineering* (London) states that several important changes have recently been made in the building regulations of Berlin, which will have the effect of facilitating the economical use of reinforced concrete in new erections. The German Concrete Association has urged that the permissible tensile stress in the steel reinforcement has hitherto been fixed at an unduly low figure. The Prussian Ministry of Public Works has announced (April 22, 1913) that in future the permissible stress will be increased from 1,000 kg./cm.^{2} (14,200 lbs. per sq. in.) to 1,200 kg./cm.^{2} (17,040 lbs. per sq. in.), the limit allowed in constructions of steel alone, provided that the steel employed has a high tensile strength, which is fixed at a minimum of 4,200 kg./cm.^{2} (59,640 lbs. per sq. in.) for ⅜-in. rod and 3,800 kg./cm.^{2} (53,960 lbs. per sq. in.) for 1¼-in. rod. The yield-point must be not less than 0:6 and not more than 0:7 of the breaking load, and the elongation not less than 25%. Steel of this quality is readily obtainable.

The Berlin building authorities accepted this regulation May 15, with the proviso that the tests of the steel must be made at the Material-Testing Station at Gross-Lichterfelde.

Changes in Chimney Designs

Certain other changes have been made by the Berlin authorities. One of these refers to reinforced concrete chimneys. The thickness of concrete over the reinforcement must not be less than 4 cm. (1½") in order to protect the steel from the action of the flue gases. The conditions under which reinforced concrete and brickwork may be used together for chimneys are also defined. Lastly, it is prescribed that staircases, cantilevers and floors may only be regarded as fixed at the ends when they are constructed at the same time as the supporting walls and carried up together. Where concrete has to be cut out subsequently, and made good after inserting artificial stone steps, etc., the degree of fixing is regarded as insufficient, and is not to be taken into account in computing the strength.

Building Projects Call for Millions

The people of Pittsburgh have been accustomed to think in seven figures, or more, for so long, that really big things that are going on in their midst either pass unnoticed or are given slight attention. As an indication, however, of what is actually being accomplished in a single line of endeavor, the following announcement of the Pittsburgh Industrial Development Commission regarding local building projects, already under way or about to be begun, is of interest:

City Hall and Court House..	$ 3,000,000
High School and Elementary Schools	3,000,000
New Hotel, Sixth Ave. and Smithfield	3,000,000
Kaufmann-Baer Department Store	2,000,000
Rosenbaum Department Store	1,500,000
Pennsylvania Freight Sta....	1,500,000
Boggs & Buhl Department Store	1,000,000
Kaufmann Bros. Department Store	1,250,000
Masonic Temple	1,000,000
University of Pittsburgh....	1,000,000
Carnegie Institute of Technology	1,000,000
Hostetter Office Bldg........	750,000
Republic Bank Note Co.....	250,000
Concordia Club	200,000
Nicola Building	200,000
Bedell Building	150,000
First National Bank of Allegheny	150,000
Dollar Savings Fund & Trust Company	100,000
Henry Buhl Building........	100,000
K. Solomon Building........	51,500
D. F. Henry Building.......	49,000
Moose Club	500,000
Model Gas Engine Plant....	500,000
Pittsburgh Furnace Co......	100,000
Republic Chemical Co. Plant	500,000
Duff Manufacturing Company	500,000
Total	$23,350,500

In addition to the foregoing, there is a large amount of building in progress in various parts of the city, the cost of which, added to the total shown above, will constitute a grand total in excess of $25,000,000.

John Monks & Co., N. Y. C., have completed a new pier for S. E. I. Maduro & Sons, in Schotgat, the inner bay at Curacao, Dutch West Indies. The pier is 530' long, 30' feet wide, wholly of reinforced concrete, on piles of the same material. A superstructure of masonry is to be over the entire pier, the whole structure fireproof. This is the first attempt to utilize the inner bay for other than anchorage, but is likely to be followed by others. This pier can be extended to 1,500' in direct line as needed.

Concrete Pontoons for a Boathouse

BY D. C. FINDLAY*

Watertight boxes of concrete, rust and teredo proof, serve as pontoons under a floating boat house. The construcitons feature are presented in detail

The universal presence of the teredo in the salt water of the ocean renders the life of wood very short, when used for supporting floating boathouses, etc. Likewise, steel pontoons require special surface coating and frequent inspection to ensure them against being corroded by the salt water. In the design of the modern boathouse described below, concrete was used for the novel purpose of building the pontoons, as it is unaffected by either, if properly constructed.

Placing Forms and Steel

The outside form assembled and the reinforcing in position is shown in Fig. 1. The walls and floor are only 2½" thick and consequently the design and installation of the reinforcing required great accuracy and care. Bars ½" square were carefully bent to the shape of the shell, and carried along the bottom and up the sides. These bars were spaced about 18 ins. o. c. A longitudinal bar having an eye turned on each end to fit, was driven down over the vertical portion of the end reinforcing bars, to about 1" from the bottom, on each side. A similar longitudinal bar was fitted near the top, and the ends were tied together with a short bar. This formed a very rigid skeleton steel frame of interlocked bars, which could not be displaced and afforded support for fastening the intermediate bars in position. On this framework was carefully spread No. 26 style triangle wire mesh.[1] The lengths were cut and formed so as to run continuously along the bottom longitudinally and up the two ends. The sides were treated likewise and the wire mesh carefully wired at every intersection with the ½-in .bars. At about 20 in. from each end a special reinforcing bar had an eye welded on it, at either end, and projected above the top of the finished side wall. This permitted chain blocks to be attached for launching, etc., and furnished means of attaching ropes for towing to the site of the boathouse.

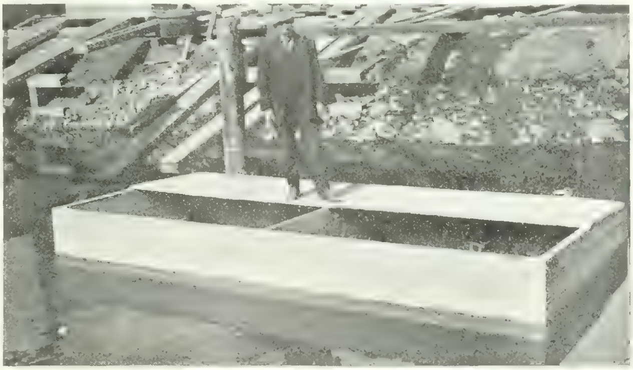


FIG. 2—A REINFORCED CONCRETE PONTOON COMPLETED

In Fig. 1 can be seen the eye-bars projecting above the edge of the forms. These are plainly shown in the above figure and are used in handling the pontoons. The pontoon shown is ready to be towed to its final position

The boathouse itself is 100' long by 27" wide and a clear height of 17' 6" to the bottom of the roof truss. Calculations of the weight of this building determined the most economical size of pontoon to be 16' long by 7' 6" wide and 30" deep.

In Fig. 2 is shown one of the finished pontoons in the water after launching. A center partition was built into the side walls and floor and consisted of "ferro-dovetail" sheets with their ends projecting 1½" into the walls and plastered with concrete on both sides. This stiffened the walls and made two separate watertight compartments.

For attaching the sills of the boathouse ¾" bolts threaded at the ends were set in the concrete about 3 ins. off the center of the pontoon, to which the 6-in. x 8-in. sills of the boathouse were bolted. This offset was calculated to be sufficient to balance the extra weight of the roof slab and cause the pontoon to float true in the water.

It will be noticed that the deck of the pontoon extends on one side only and the end walls were cast with a 2" fall from the center. This portion of the pontoon is outside the building line and the roof sheds the rain. The roof is made of "ferro-dovetail" sheets with a groove ⅝" deep resting on the center partition wall and fastened to the ends and side by ⅜-in. carriage bolts which were placed in the green concrete. Both top and bottom of the sheets were then plastered with a 1:2 mixture and the finished roof slab was only 1¼" thick but of remarkable strength, and absolutely watertight.

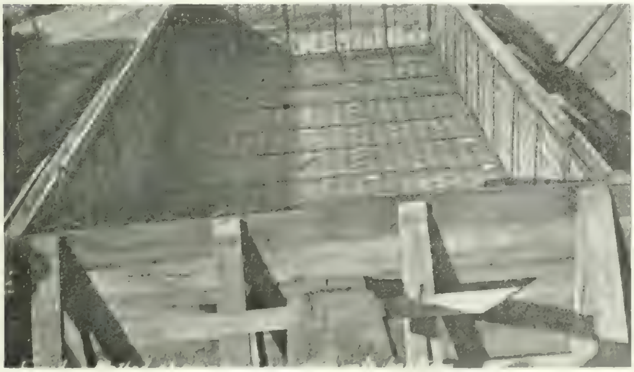


FIG. 1—[illegible] FORMS FOR A CONCRETE PONTOON

This shows in [illegible] ready and the reinforcing steel in place. The first operation is to pour the floor, then quickly place the forms for the inside wall and continue the [illegible]. The pontoons are 7' 6" wide by 16' long by 2' 6" high. The walls are 2½" thick.

Weight and Floating Power

In order to get all the buoyancy possible, every pound of weight possible had to be eliminated. As constructed, the pontoons weighed about 8,000 lbs. and, on launching, floated to within ¼" of calculated water line. Each pontoon supports a live load of about 7,800 lbs.

The boathouse under description has 11 pontoons under it, five on either side and one on the forward end, while the other end of the building containing the large swinging doors was tied together by a 1½-in. iron bar attached by galvanized bolts to the top of the pontoon, and passing between guide bolts set in the bottom, so as to distribute the load in a vertical plane. The horizontal part of the tie-rod was 6' below water, al-

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*Ch. Engr. Victoria Portland Cement Co., Victoria, B. C.

[1] Am. Steel and Wire Co., Chicago

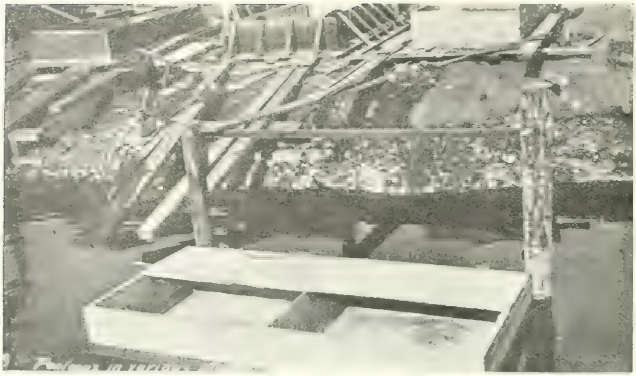


Fig. 3—This Shows Pontoons in Various Stages of Construction

On the bank at the left is shown a pontoon ready for the deck construction. In the center up on the bank is shown a pontoon with the outside form and steel plate as shown in Fig. 1. At the right on the bank is shown a completed pontoon, and one is in the water in the foreground already launched. The launching ways are shown plainly in the center

lowing the yacht to pass over it in entering the boathouse.

General Features

The building is rigidly built and braced and the roof supported by trusses, both roof and walls being covered with a special *V* crimp galvanized iron with a paneled lattice running around the entire building. In Fig. 4 is shown an interior view, with the walks around either side. Manholes in the floor allow inspection of the inside of the pontoons, which are used for storing light material used about the yacht. The boathouse is held in position at one end by a reinforced concrete pile 24″ sq., and at the other end by a floating boom attached to the shore. A floating fender attached by spreaders to the sill was installed to prevent the yacht ramming the pontoons in making a landing alongside the boathouse. Landings are provided at the entrance to facilitate boarding the yacht. One end of the front of the boathouse is partitioned off for a room for the captain.

The entire building is lighted and heated with electricity and has fresh water piped all over for quickly filling the yacht's tanks and for cleaning purposes.

In constructing the pontoons, 3 casting floors were built on the beach, of shiplap, and carefully leveled up. These served as forms for the bottom of the pontoon and two sets of collapsible wood forms were then made up, which were used over 15 times in all. The outside forms were first set up and the reinforcing carefully placed and supported from the bottom by small concrete blocks which were cast into the

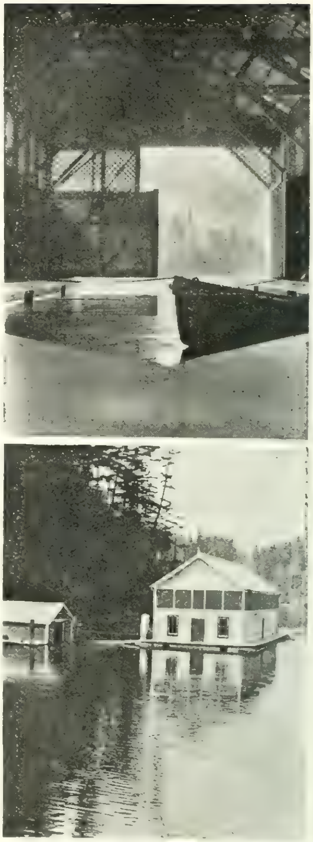


Fig. 4—The Interior of the Completed Boathouse is Shown in the Upper Illustration, Below is Shown an Exterior View

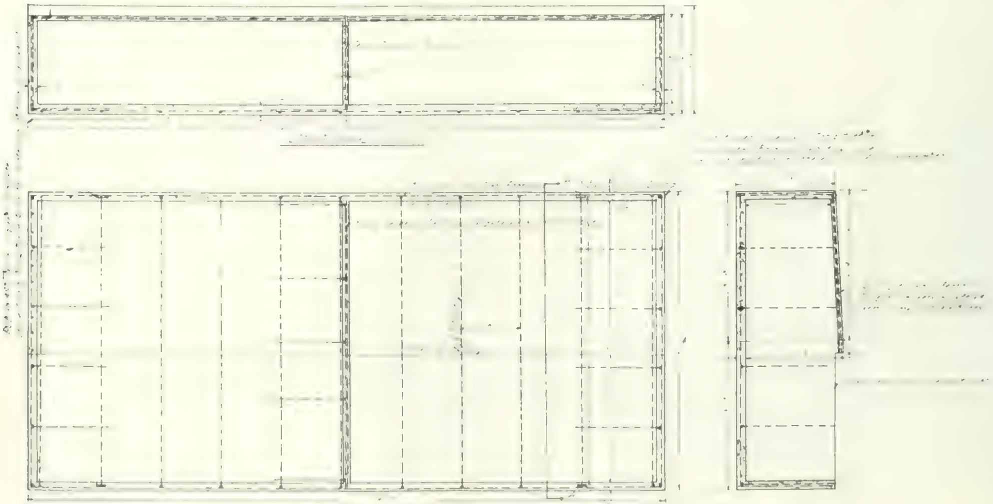


Fig. 5—Plan and Sections Showing in Detail the Construction of a Reinforced Concrete Pontoon

floor. The floor was then poured, using a wet 1:2 mixture. This covered the steel completely and was very thoroughly tamped to fill all the voids.

A mixture of 1:2:1, using for the aggregate screened gravel passing a ½-in. ring, was then poured on top and brought to a depth of 2½". The collapsible inside form was then qiuckly set in place, and braced into alignment, and the concreting of the walls continued without a break. Very great care was used in the mixing, and especially tamping the thin walls to assure the steel being thoroughly enclosed and all air expelled. Very gratifying results were obtained, as of 15 pontoons built, not one showed any indications of dampness of any sort when launched, and they have been in the water now for nearly 9 mos.

Forms were stripped in about 36 hrs. and allowed to season till thoroughly set, when a frame was placed over either end, and chain blocks used to lift the pontoon clear of the floor, when launching timbers, 10" x 14", were placed under on rollers. At high tide the pontoon was about 6 ft. above the water; an incline runway was built extending into the water and a temporary roof built over the open side of the pontoon to prevent shipping water on launching. Two men with bars easily pushed it off the floor and it took the water very easily. A motor boat then took it in tow for about a mile to the site of the boathouse where it was assembled.

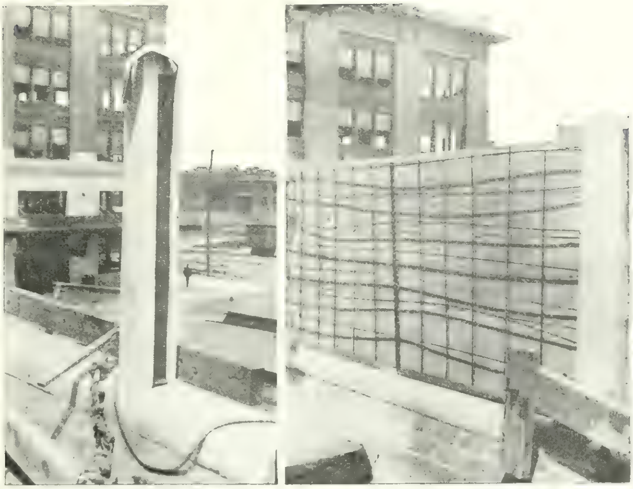
Accurate account was kept of the cost, which amounted to $78 for each pontoon, including launching.

Considering their indestructibility, they are far superior to anything else and prove that concrete itself, if well placed, is a sufficient waterproofing agent, as no waterproofing was used in the concrete.

The pontoons and boathouse were designed and built under the direction of D. C. Findlay, A. M. Can. Soc. C. E., Ch. Engr. the Vancouver Portland Cement Co., Ltd., Victoria, B. C., for R. P. Butchart, managing director of the company.

Even the mummies who have stood the wear of centuries are getting into line and at this late day find they "need concrete in their business." London papers tell us "that the roof over the Egyptian Dept. of the British Museum is being raised and replaced by a structure of reinforced concrete in order to render the department fire resistant and to improve the lighting of the collection." Will the pyramids be "next" in the use of the great modern building material?

In a recent issue of *Engineering and Mining Journal* a correspondent discusses the use, in silver assaying, of cement cupels. Bone-ash cupels, according to the correspondent, are not all that might be desired, and in many ways cement offers very good material.



At the Left is Shown a Post Cast in Place and Ready to Receive the Curtain Panel. At the Right is Shown the Outer Form and the Steel in Place

The tar paper placed in the slots of the post is plainly shown. At the right are shown at the bottom the wooden strips which make the openings along the bottom of the wall

Concrete Fences for Elevated Tracks

In Jamacia, Long Island, which is now a part of Greater New York, the Long Island R. R., backed by the Pennsylvania R. R., is spending millions in terminal improvements and yard work. The great bulk of the trackage at Jamacia is elevated and the railroad engineers have been using as a guard-rail along the side of their elevated track work a concrete wall without openings which has many interesting features.

In building railings and guard walls for concrete bridges, especially arch bridges, the question of taking care of the expansion and contraction is very important and precautions are always taken to eliminate cracks in the guard-rail. The method shown in the accompanying illustration is one that has been developed by the engineers of the Long Island R. R. and is especially interesting as it has been used on their work with satisfactory results.

At the left of the illustration is shown the post which is cast in place. When the parapet wall is poured, reinforcing steel is left projecting at the places where posts are located. These are used to tie the posts into the top of the parapet.

In each side of the posts are left slots about ¾ in. deep, and the corners of the posts are chamfered and the top is beveled. In these slots are placed several thicknesses of tar building paper and the curtain wall in between the posts is poured in place. This is done as follows:

Panels are built of timber of such dimensions that they will fit in between the concrete posts and are as wide as the wall is high. These are put in place and held in place by a pair of waling strips which are in turn held at the proper distance by bolts. This panel wall is reinforced as shown at the right of the illustration. The steel is wired to keep it in position.

A close examination of the illustration at the right shows small triangular strips placed at the bottom of the panel. These are to provide drainage below the solid wall. When the panel is removed the strips are knocked out, leaving a chamfered opening along the bottom. Where the heavy vertical steel comes up at the center of the panel these strips are left out, making a shoe resting directly on the parapet wall and helping to carry the curtain wall.

The posts when completed and before the curtain panel is placed are rubbed down with a wire brush, exposing the aggregate sufficiently to produce a good effect. The panels when completed are rubbed smooth with cement and water making a pleasing contrast to the post.

Construction in Formosa

In Taihoku, Taiwan district, Formosa, a new government capitol is rapidly nearing completion. The total cost of this building will be $1,250,000, and it is to be completed in April, 1915. For the fiscal year the Japanese Imperial Diet at the 1913 session appropriated $348,600 for construction costs. Reinforced concrete is being used extensively in the substructure and superstructure. The steel is being furnished by the Trussed Concrete Steel Co., Detroit.

Iowa Road Men Inspect Wayne County Work

The first step toward building permanent highways in Iowa was taken last winter when the state legislature enacted a law providing for the creation of a state highway commission and the office of county road engineer in each of the 99 counties of the state. The new commissioners and engineers are engaged this summer mapping out roads and preparing for the construction of hard surfaced across-the-state highways. Before they begin actual work, however, they are endeavoring to learn from others of best methods and best materials. Recently a party of them accompanied by prominent road enthusiasts from all over the state took special train for Detroit to inspect the roads of Wayne county, Mich. At Detroit they were met by automobiles and with Edward N. Hines, of the Board of Wayne County Road Commissioners, as guide and demonstrator, drove for 60 miles over the concrete roads of the county stopping frequently for close inspection.

How favorably they were impressed is learned from the following remarks of prominent members of the party.

"We went with certain mental reservations," said J. L. Long, editor of *Road Maker*, Des Moines. "We go away convinced."

J. W. Holden, of the State Highway Commission, made the declaration, "I shall be surprised if the next Iowa legislature does not pass a law making it possible to bond the counties for permanent trunk roads, if not concrete, at least with some surfacing that may prove better. At the present time, however, I know of nothing that compares with what we have seen in Wayne county."

Dean A. Marston, of the Iowa State Agricultural College, and also a member of the Highway Commission, has expressed himself this way, "While conditions on unimproved Iowa roads are not so desperate, due to soil conditions as they are in Michigan, the Hawkeye state will keep abreast of the times and it looks as though concrete offers the solution for present road conditions."

Already there are a few concrete roads in Iowa. Twenty miles have been laid near Sioux City and pronounced a success. In Cerro Gordo county near Mason City, about 30 more miles have been built. Smaller stretches have also been constructed at several other places in the state.

Road Building Kinks

Wayne County, Michigan

A Poor Mix

Accidents will happen even in the best regulated work, but such accidents as may be guessed at in the two views shown herewith should be and are, usually on Wayne county work, carefully guarded against. These pictures were taken August 15 on the Michigan avenue road just west of Denton when the concrete construction on this Wayne county road was completed to the county line except for about 200 lin. yds. At this stage of the operation with a little more than a day's work ahead of the gang, there was a shortage of sand. Rather than stop the work or move the gang and the equipment and wait for the delivery of more sand, the man in charge of these operations chose to alter the mixture and instead of a mixture of 1 part of cement, 1½ parts sand and 3 parts pebbles, he sought to make the sand last through the day by using approximately 1 part cement 1 part sand and 3½ pebbles. In other words he subtracted about half a wheelbarrow load of sand and added about half a wheelbarrow load of pebbles and the result in the upper view, Fig. 1, is clearly shown in a mixture going out of the bucket with insufficient mortar. With this mix the water ran away with the cement and the pebbles were left as shown in Fig. 1. Considerable spading was required to get this concrete into any kind of satisfactory shape and the progress of the template, as indicated in Fig. 2, was rather slow and somewhat difficult because the stones had to be forced down into what little mortar there was to hold them.

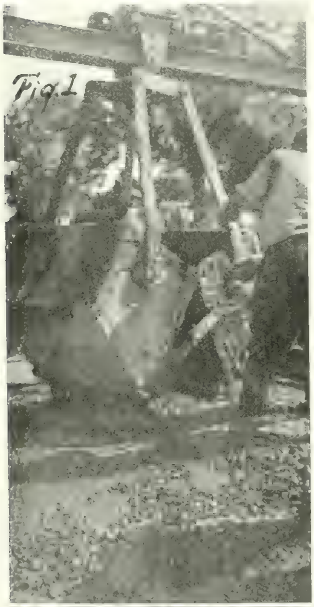


Fig. 1

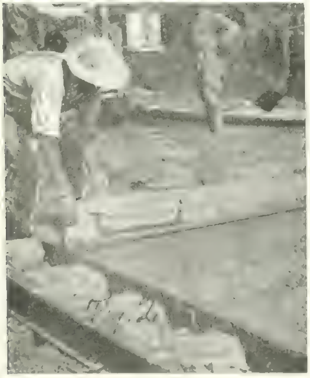


Fig. 2

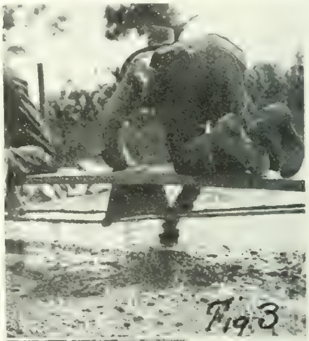


Fig. 3

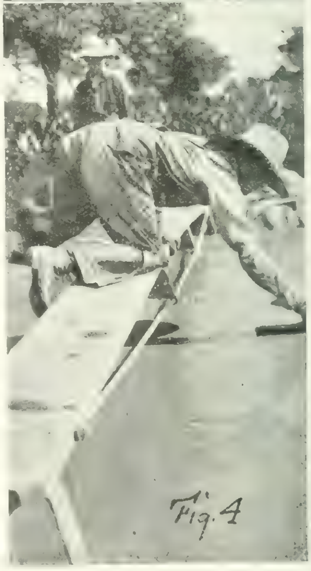


Fig. 4

Fig. 3 shows the finishers on their bridge spanning the concrete work trying to smooth up this surface. The picture plainly shows the sharp line to which they have finished and it shows the concrete back of them with the protruding pebbles. Fig. 4 shows the surface just about as it was left by the finishers. If the matrix which is lacking in sand is not sufficient to bind the stones, a short piece of this road may fail and somebody may come along and point to it as another failure of concrete roads. This, however, is an unusual condition and if this piece does fail, the reason will be apparent.

Experimental Road Work in Ohio

STAFF ARTICLE

The Highway Department of Ohio did not proceed with any extensive work in the construction of concrete highways until it had conducted experiments to determine relative wearing qualities of various road materials. Thus, in 1910 only 1.49 mi. of concrete highway were under contract and in 1911 only 1.25 mi. In 1912 several contracts were let for a total of 40.39 mi. of concrete roads and bids are being taken and contracts let for much more of the same work this year.

The experiments[1] which led up to this growing exhibition of confidence were begun in the summer of 1909 on Nelson avenue—extending north from Broad street, Columbus, and the work is near the city and the road undergoes fairly heavy travel. In building test sections, each of which is approximately 400′ long, arrangements were made to do the work on a force account, paying the contractor 15% of the payroll for his outfit and services.

Nelson avenue had been macadamized several years before and there was a good foundation for new work. The old road was spiked up, new stone added and it was then rolled and watered to the condition of a finished waterbound surface.

The accompanying table names the various sections—most of them macadam with different treatment. The limestone concrete was a rather dry mix rolled in place and did not prove satisfactory. The table shows the cost of each section.

In order to provide a record of the wear on the different sections, levels were taken over the road on December 22, 1909, soon after the completion of the work. The points at which the levels were taken were carefully located so that it is possible to ascertain the amount of wear by releveling at any time. Readings were taken on the center line, and at 4′ and 8′, both east and west of centers, at five stations on each section, making a total of 25 readings on each section of 400′.

The work was releveled in September, 1910, and again on November 11, 1911. The differeences in elevation are shown in hundredths of a foot in the annexed table, and the amounts are the average of five points on each section.

Several causes contribute to the difference in elevations noted on December 22, 1909, and November 11, 1911.

1. On December 22, 1909, the day on which the first levels were taken, the ground was frozen to a depth of several inches, while on November 11, 1911, the day on which the last set of levels were run, there was no sign of frost. The frost on December 22, 1909, undoubtedly caused the road surface to be higher than when there was no frost present.

2. The wear resulting from traffic naturally would lower the surface of the road.

3. The exuding of the binder on the treated scetions during the warm weather caused a raise in surface elevation at many points.

4. The surface of the sections located near the intersecting roads has been raised somewhat by mud being carried onto the roadway from adjoining earth roads.

5. Many of the treated sections were covered with an excess of screenings when first completed. These screenings rapidly wore away until the wearing surface of large stone was exposed. This resulted in a rapid rate of wear for the first year.

Causes 3 and 4 tend to counteract the effects of causes 1, 2 and 5.

The experience of the highway department of Ohio after watching seventeen 400-ft. experimental sections for two years and perhaps more especially in noting conditions of wear which are given in the table, page .., undoubtedly led up to more active work in concrete highway construction which was done in 1912, when contracts were let for more than 40 mi. of this work, not all of

TABLE SHOWING WEAR ON THE NELSON AVENUE EXPERIMENTAL ROAD FROM DECEMBER 22, 1909, TO NOVEMBER 11, 1911.

	Section	8 ft. east	4 ft. east	Center Line	4 ft. west	8 ft. west	Average* ft.	Cost of for 400 Section*
1.	Glutrin	.08 ft.	.09 ft.	.05 ft.	.01 ft.	.04 ft.	.054 ft.	$560.78
2.	Standard Asphalt	[illegible]	.10 ft.	.06 ft.	.06 ft.	.09 ft.	.07 ft.	446.69†
3.	Pioneer Asphalt	.05 ft.	.03 ft.	.03 ft.	.03 ft.	.08 ft.	.044 ft.	663.26
4.	Tarvia "X"	.01 ft.	05 ft.	.06 ft.	.08 ft.	.05 ft.	.05 ft.	570.80
5.	Travia "B"	.08 ft.	.03 ft.	.04 ft.	.03 ft.	.04 ft.	.044 ft.	497.24
6.	Indian Asphalt	.01 ft.	.06 ft.	.05 ft.	.06 ft.	.05 ft.	.046 ft.	500.09†
7.	Ugite	.05 ft.	08 ft.	.09 ft.	.08 ft.	.05 ft.	.07 ft.	651.98
8.	Fairfield Asphalt	.06 ft.	08 ft.	.07 ft.	.06 ft.	.02 ft.	.058 ft.	[illegible]
9.	Asphaltoilene	.08 ft.	05 ft.	.07 ft.	.10 ft.	.09 ft.	.078 ft.	[illegible]
10.	Rock Asphalt	.11 ft.	.05 ft.	.06 ft.	.07 ft.	.09 ft.	.076 ft.	751.70
11.	Carbo Via	.02 ft.	11 ft.	.12 ft.	.12 ft.	.07 ft.	.088 ft.	568.95
12.	Concrete Macadam	.06 ft.	08 ft.	.08 ft.	.05 ft.	.07 ft.	.068 ft.	481.44
13.	Taroid	.04 ft.	09 ft.	.10 ft.	.08 ft.	.03 ft.	.068 ft.	[illegible]
14.	Petrolithic	.04 ft.	.02 ft.	.08 ft.	.05 ft.	.03 ft.	.044 ft.	622.60
15.	Limestone Concrete	[illegible]	04 ft.	.03 ft.	.01 ft.	.03 ft.	.032 ft.	[illegible]
16.	Gravel Concrete	.01 ft.	.00 ft.	.01 ft.	.01 ft.	.05 ft.	.016 ft.	507.90
17.	Waterbound Macadam	.04 ft.	08 ft.	.08 ft.	.06 ft.	.04 ft.	[illegible]	[illegible]

†Binder donated

*The column showing average wear and that showing cost we prepared and added to the table published by the Highway Department [illegible]

Road Building Kinks

Wayne County, Michigan

FLOATING THE SURFACE

This picture taken on the Warren road , July 26, shows the finishers at work. It will be noticed that the bridge is directly over an expansion joint and that the T-iron has been removed. The surfacing is done (after the template has passed) using a home-made wooden trowel which consists of a light handle attached to a ⅞-in. board, 16″ long and 4″ wide.

A reader of Concrete-Cement Age, who had looked into the matter of surfacing to a considerable extent, suggested the other day that the float or trowel or whatever is used, should be wielded in a motion away from the joint, rather than toward it, for the reason that the action of the trowel or the float is to carry fine particles of neat cement with it. This fine material, which is by no means the strongest, would, in troweling toward the joint, lodge in a heavier coating next to the joint, thus making the concrete weakest, where it should be strongest, if it is to resist the pounding which is occasioned by the slightest irregularity in the surface at the joint. It was noticed, however, in the Grosse Pointe work that the use of the T-iron at the joint and the approach of the template to this iron results in the accumulation of surplus material at the joint, and as has already been pointed out in describing other construction kinks, in this issue, while most of the surplus is removed with a shovel, there is usually a trifle too much material when the T-iron has been removed and the finishers with their floats get to work at the joints. The natural tendency, therefore, is to float this surplus back from the joint, and it was noticed that the finishers were doing just this and practically all of the strokes of the float were away from the joint rather than toward it.

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[1] Described in Bulletin [illegible] of Ohio Highway Dept.

Road Building Kinks

Wayne County, Michigan

TRIMMING THE EDGES

This picture was taken on Michigan avenue, just west of Denton, Aug. 15. As soon as the concrete has set firmly enough so that the side forms can be removed, a man goes along the edge of the concrete and trims it off with a shovel as shown. It happens that this edge shown in the photograph comes next to the electric railway line, so there is hardly any shoulder construction to be done. Where the shoulders do come, it is important that this construction of gravel and crushed stone lap over the edge of the concrete in such a way that there is no sharp edge of concrete to break off under traffic in running over the shoulder onto the concrete, and over the concrete to the shoulder. It was proposed by the County Road Commissioners at one time to use side forms with a bevel strip of some kind, which would make it possible to leave the edge in proper condition without trimming off afterward. Further consideration of the matter, however, led to the belief that the additional labor required in getting the concrete well placed under such forms would more than counterbalance the waste of concrete and the labor occasioned in trimming off.

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which was completed last year. More contracts are being let this year and tenders on other work being asked for. The roads are being built in 12-ft., 14-ft. and 16-ft. widths, and in most of them, the concrete is 7″ thick in the center with a crown of ¼″ to the foot on a flat subgrade. Although the highway department seems to have been much pleased with the results of experiment No. 16 with gravel concrete, on the Nelson avenue work, as described on foregoing pages, in all probability the transverse cracks coming at fairly regular intervals, as reported, led to the adoption of predetermined joints every 30′. These joints are being filled with tar or asphalt but are not given any special protection in the way of steel plates. The specifications for concrete highway work which are given below do not definitely require washed material.[1]

Following are the Ohio specifications in abstract:

Materials

Limestone or slag for concrete shall meet the following requirements: In the abrasion test a per cent loss of not more than 10, a factor of hardness of not less than 12 and a factor of toughness of not less than 5.

Gravel shall consist of granite, quartz or limestone pebbles. These pebbles shall be of spherical or ellipsoidal shape and of a hard, tough and durable material.[2]

Immediately before any concrete is placed, the sub-grade must be in a moist condition. Where the sub-grade is dry and of a porous nature, the above mentioned condition shall be secured by sprinkling.

Wherever it is possible to do so, the concrete materials shall be stored outside of the portion of the road to be paved.

The ingredients of the concrete shall be mixed in the proportion of 1 sack of cement to not more than 1½ cu. ft. of fine aggregate and 3 cu. ft. of coarse aggregate. A cu. yd. of concrete in place between neat lines shall in no case contain less than 7 sacks of cement.

Fine aggregate shall consist of durable particles of sand, crushed stone or gravel screenings which will pass a screen having openings ¼″ in diameter, and which shall be graded down uniformly to particles passing a No. 40 screen; provided, however, that not more than 30% of the material will pass through the No. 40 screen. Fine aggregate shall be of such a quality that mortar composed of 1 part Portland Cement and 3 parts fine aggregate, by weight, when made into standard briquettes will show a tensile strength at least equal to the strength of 1:3 mortar of the same consistency made of the same cement and Standard Ottawa sand.

Coarse aggregate shall consist of crushed boulders, crushed limestone or gravel that will pass through a screen having openings 1½″ in diameter and be retained upon a screen having openings ¼″ in diameter. Each particle shall be clean, hard, durable and free from all deleterious matter. It is required that the material be uniformly graded from fine to coarse between the sizes above specified.

Water to be used shall be free from sewage, oil, acid, strong alkalies, or vegetable matter, and shall be reasonably free from clay or loam.

Mixing and Placing

The mixture should be rather wet but not sloppy.

When the completion of a section extending between expansion joints is unavoidably interrupted, cross-forms shall be so placed as to produce a vertical joint parallel to the expansion joint. When the placing of concrete is resumed, the cross-forms shall be removed and the new concrete so placed that there will be practically no space between the old concrete and the new.

After the surface of the concrete has been shaped by the use of the template, it shall be floated in such a manner as thoroughly to compact the concrete and produce a surface which conforms to the exact crown shown on drawings. As soon as the concrete has taken its initial set, its surface shall be roughened with a wire broom drawn from center to sides of the pavement. The finished surface of the concrete shall conform so nearly to that indicated on the plans that it will nowhere vary more than ½″ from the previously described template or a 10-ft. straight edge applied to the surface of the concrete and parallel to the center line of the pavement.

At intervals of 30′ there shall be constructed transverse expansion joints. Such joints shall be straight and perpendicular to the center line of the pavement, shall extend through the full depth of the concrete and corresponding points on the two edges of the joints shall be at the same elevation. Expansion joints shall be constructed by one of the following methods:

1—A steel plate cut to the exact cross-section of the finished pavement shall be placed at the end of each section and firmly held in position by stakes until the work of placing the concrete has progressed to a point not less than 2′ beyond the joint. The stakes shall then be pulled and the plate allowed to remain in place until the concrete has hardened sufficiently to retain its shape. Great care must be exercised in removing the plate in order that the edges of the concrete will not be cracked or broken. The plates must be frequently cleaned and oiled to prevent adhesion of the concrete. The completed joints shall not be less than ¼″ nor more than ½″ in width. The joints shall be poured full of properly heated tar or asphalt of such a quality that it will not run at a temperature of 100° F. and will not be brittle at 0° F.

2—Expansion joints may be formed by inserting during construction and leaving in place a total thickness of ¼″

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[1] [illegible] perienced in getting clean materials into some of [illegible] Scotland, O., the gravel used is practically all quartz and as it comes out of the pit nearby, is coated with a fine red dust. This work was visited on a day (July 26) when construction operations were not in progress, but there were no evidences that the material was being washed, although a certain portion of this dust, apparently was being screened out. Part of this Scotland road built last year is showing quite a few cracks, particularly in the low part of the road toward the foot of a hill.

[2] The quartz pebbles being used on the Scotland road (see footnote 1) are nearly all ellipsoidal and rather smooth—so smooth that with the least coating of dust a good mechanical bond would seem almost impossible the sharp pieces in the aggregate are the exception.

of tarred paper or felt treated with tar or asphalt.

Curing

Within 1 hr. after the surface of the concrete has been floated, it shall be protected by means of a canvas covering which must be left in place for at least 12 hrs. The concrete shall be protected by a suitable covering and kept wet for a period of not less than 5 days from the time it is laid.

Road Building Kinks

Wayne County, Michigan

Curing

These pictures show how Wayne county scrupulously observes essentials in taking care of the concrete after it is laid, and before it has taken its final set. Each day's work is covered with canvas and by the next day the concrete has become sufficiently hard to bear the weight of an inch or two of earth of almost any kind which is available. The canvas is then removed and the earth put on. This is left on for at least eight days and the concrete is kept wet during that time. Crazing isn't seen in the Wayne county work.

The contractor shall take proper and adequate precautions to keep all classes of traffic off the pavement until the concrete is permanently set, and in no case shall this period be less than 10 days.

Work in Progress

Some of the more important work being done now by the State Highway Department are roads as follows:

In Harrison county, 2.58 mi. on the Scio road, concrete 10′ wide, contract price $23,289. (about $1.53 per sq. yd.)

In Miami county, 4.14 mi. on the Piqua-Troy road, 16′ wide, contract price, $38,930 (about $1.00 per sq. yd.)

In Lucas county, 2.15 mi. on the Monroe turnpike, 16′ wide, contract price, $31,925.80 (about $1.58 per sq. yd.)

In Licking county, 3.92 mi. on the Newark and Granville road, 16′ wide, contract price, $40,670 (about $1.10 per sq. yd.)

In Sandusky county, 2.18 mi. on the Port Clinton road, 16′ wide, contract price, $22,900 (about $1.12 per sq. yd.)

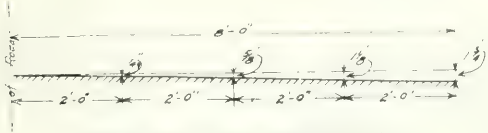
In Summit county, 2.38 mi. on the Ghent road, 14′ wide, contract price $26,239.89 (about $1.34 per sq. yd.)

In Trumbull county, 2.69 mi. on the Hartford Northern road, 12′ wide, contract price, $18,400 (about 97c per sq. yd.)

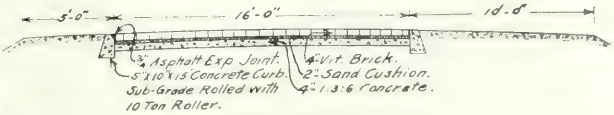
All of this work is to have a bituminous surface with the exception of the Ghent road, Summit county, this cost being included in the contract price.

Following up the experimental work done in 1909, 1910 and 1911, the road on S. High street out from Columbus was begun last year. The road completed in 1912 is 3,100′ long with 16′ of metal and 5-ft. berm on the west side and a 10-ft. earth drive on the east. Sections 1 to 16 are of brick, 50′ in a section; section 17 is of asphalt block, 49.3′; section 18, Petrifalt, 401.5′; section 19, Dolarway, 381′; section 20, concrete with Tarvia coat, 528′; section 21, plain concrete, 457′; section 22, Hassam concrete, 484′.

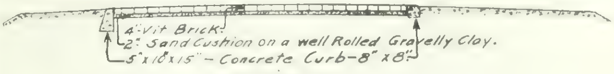
The work was done by force account under the supervision of the State Highway Department, A. H. Hinkle, engineer of maintenance being in direct charge. Convict labor was used. Sec-



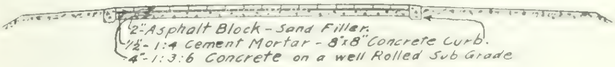
DETAIL OF CROWN, SECTIONS 1-22



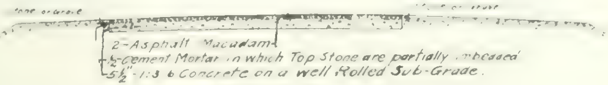
SECTIONS 1-15


4″ Vit Brick.
2″ Sand Cushion on a well Rolled Gravelly Clay.
5″x10″x15″ – Concrete Curb – 8″x8″

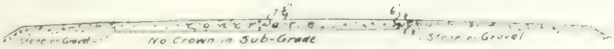
SECTION 16


2″ Asphalt Block – Sand Filler.
1/2″ – 1:4 Cement Mortar – 8″x8″ Concrete Curb.
4″ – 1:3:6 Concrete on a well Rolled Sub Grade

SECTION 17


Stone or Gravel
Stone or Gravel
2 – Asphalt Macadam
1/2 – Cement Mortar in which Top Stone are partially imbedded
5 1/2″ – 1:3:6 Concrete on a well Rolled Sub-Grade.

SECTION 18



SECTIONS 19-22

[illegible], Ohio Experimental [illegible] tions 1 to 15 of the brick road, are laid on a 4-in. base of 1:3:6 gravel concrete with a 2-in. sand cushion. Section 16 is put on a 2-in. sand filler only. The soil underneath is a gravelly clay. The brick was rolled with a 5-ton tandem roller. Sections 1 to 5 have a sand and asphalt filler. Section 6 has an asphalt filler and sections 7 to 16 have a filler of grout, 1 part cement, 1 part sand, with 1½ buckets of water to 1 bucket of cement for the first application, less water for the second, and a third application where the first two settled. This work was done according to directions of Secretary Blair of the National Paving Brick Manufacturers' Association.

The asphalt block was put in on a 4-in. base of a 1:3:6 concrete, with a ½-in. of cement sand mortar.

Petrifalt

The Petrifalt section consists of 5½″ of 1:3:6 gravel concrete, the aggregate passing a 2½-in. ring, with 21.7% retained on a 1¼-in. ring, and 6% passing a ⅛-in. ring. This was washed gravel. Over this was placed ½″ of 1:3 mortar.

Before the bottom course had set, and on this work, while still fresh, was placed a 2-in. layer of crushed stone from 1″ to 2″ in size. This was lightly tamped and was left with the stone projecting above the concrete base. After 10 dys. this irregular surface was evened up and gone over with a 10-ton roller. There was then an application of Byerlite asphalt, 1½ gal. to the sq. yd. Over this was thrown stone screenings and again rolled. A second coat of Byerlite was put on using ½ gal. per sq. yd. Owing to a lack of asphalt on the job at the time the work was being done, this final coat was omitted on part of the section. The asphalt was not very evenly applied and there has been a tendency to creep.

Dolarway

The Dolarway section, from Station 12+50 to Station 16+50, a distance of 400′, is divided into two kinds of construction. The first 200′ is of crushed stone concrete, using stone from 1¼″ to 3″. Part *A* of this 200′ is a mixture of 1 part cement, 1½ parts sand, and 3 parts stone. Part *B* consists of 100′ using a mixture of 1 part cement, 2 parts sand, and 4 parts stone. The remaining 200′ is of gravel concrete, using gravel from ¼″ to 2″, and this in turn is divided into two parts. Part *C*, 100′ long, is of a 1:1½:3, and part *D*, 100′ long, is of a 1:2:4 mix. This concrete base is 7¾″ thick in the center, 6″ at the edge, and a wet mix was employed throughout.

Joints ¾″ wide were placed about every 30′ and were filled with tar and sand, and in settling, were refilled with asphalt. Most of the joints were not protected in any way. At Station 13+44 a paving brick joint was put in. At Station 14+22 the concrete was poorly placed, leaving quite a depression and an attempt was made to patch it up with cement mortar. At Station 14+72, Baker plates have been used and one slab is protected at one outside edge with clip bars made by the Clip Bar Mfg. Co. All the concrete work was not covered while setting but was sprinkled twice a day for 5 days. The weather in that time was generally cloudy.

In the first application of Dolorway bitumen, about 0.35 gal. per sq. yd. was applied, and as much torpedo sand was used as the bitumen would absorb. From Station 12+50 to Station 12+83, the surplus sand of the first treatment was brushed off and another treatment of bitumen was given, using 0.3 gal. per sq. yd.

Tarvia Coat

Section 20, 500′ long, from Station 16+50 to 21+50, was covered with a Tarvia coat. This work is divided into 6 parts. Parts *A* and *B* are of hard limestone concrete, stone being ½″ to 2½″. Part *A*, 100′ long, is 1:1½:3 mix, and part *B*, 100′ long, 1:2:4 mix. In parts *C* and *D*, soft limestone was used; part *C*, 50′ long, 1:1½:3 mix, and part *D*, 1:2:4 mix. Parts *E* and *F* are of gravel concrete, using gravel ¼″ to 2½″; part *E*, 100′, is 1:1½:3 mix, and part *F*, 100′, 1:2:4 mix.

One joint at 16+81.5 was protected with a Trussed Concrete Steel Co. bar, and at Station 17+97, Baker plates were used with three layers of tarred paper. At one place on this work, the concrete was tracked by a bicycle. This track was filled with mortar and leveled off.

Plain Concrete

The plain concrete section 21, 500′ long, from Station 21+50 to 26+50, is also divided into 6 sections, using precisely the same materials as were em-

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Road Building Kinks

Wayne County, Michigan

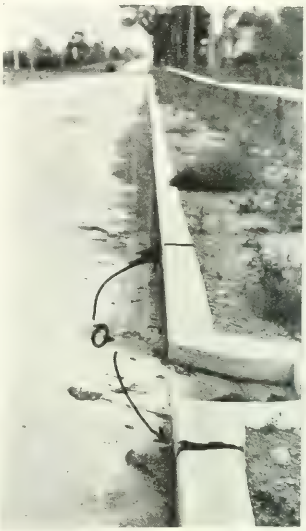
Back Filling Along Curb

On the Grosse Pointe road where this picture was taken Aug. 9, pavement is laid between old stone curbing. It was considered impossible to work the template properly and get a good surface by using curbs for side forms, so the forms were set up in the usual way, 5 in. or 6 in. inside the stone curb. After these side forms were taken up, a strip of asphalt felt was put in next to the curb and back filling was done between the pavement slab and the curb, the concrete being wheeled back in barrows and finished off with floats. An effort was made to get a good tight joint with the pavement and to keep the back filler separate from the curb by means of the strip of felt. Joints were placed in this back fill at the same intervals as in the pavement slab, and the picture shows the back fill brought up to a joint in the pavement. This work is done about a half a day behind the paving.

Road Building Kinks

Wayne County, Michigan

Drains



This illustration from a photograph taken on Grand River avenue, Aug. 9, shows curb construction and a side drain. At this particular place on the Grand River road, a deep fill was required for a considerable distance in order to widen the highway, and it was considered highly important that the water from the pavement be allowed to wash just as little as possible at the edges, hence the construction shown. The water is carried along the curb to the drain as shown in the picture, and thence underground outside the embankment. It will be noticed that joints have been made in the curb as at *a*, using asphalt felt like that which is used between the steel plates in pavement construction ployed in section 20, and in the same order, omitting the bituminous surface.

Hassam

The Hassam pavement section 22, 400′ long, is divided into various parts with different construction as follows:

Top 3″ rolled crushed gravel 1¼″ to 2½″ filled with 1:1½ mortar, 50′. (a) Base rolled crushed limestone (Columbus) 1¼″ to 4″ filled with 1:3 mortar (top treated with pea gravel). (b) Same section as (a) except top to be of Marion stone, 50′. (c) 6″ rolled limestone (Marion) size 1½″ to 3″, filled with 1:1 mortar made from limestone screenings, 50′. Top treated with pea gravel before rolling is completed. (d) Same as (c) except mortar 1:1½, 50′. (e) Same as (c) except mortar 1:2, 50′. (f) Same as (c) except gravel (1½″ to 3″) and sand mortar, 50′. (g) Same as (d) except use gravel and sand mortar, 50′. (h) Same as (e) except use gravel and sand mortar, 50′.

Considerable difficulty was experienced at various stages of the concrete work because of the inexperience and not too intelligent convict labor. Building only a short section of one kind of work there was no opportunity to train the laborers. Further, the appropriation was running low and some makeshift methods and materials were resorted to which do not promise the most satisfactory results.

Community Losses Due to Bad Roads and Pavements

One of the most thorough investigations of the subject (losses by bad roads) ever conducted, the results of which are used as a text wherever the doctrine of good roads is preached, was made by the Minneapolis Civic and Commerce Association. While the conditions investigated were those of territory tributary to Minneapolis, they are undoubtedly typical, to a greater or less degree, of those existing elsewhere.

A committee of the association selected for investigation the farming district, 750 square miles in area, the trade of which is tributary to Minneapolis. From a thorough canvass of the conditions existing there it was found that the 4,069 farmers in the district hauled 560,000 tons of farm produce to market in 1911 and sold it for $6,665,680. To do this they had to make 305,000 trips, the time spent equalling 800 years of eight-hour days and the distance covered eighty-eight times the circumference of the world. Bad road conditions caused losses in time, partly due to slow progress, partly to the necessity of taking less direct routes, and partly because smaller loads had to be carried. Detailed investigations showed that the losses in time were as follows: Due to not taking the shortest route, $62,000; due to slower progress, $75,000; due to extra trips necessitated by smaller loads, $159,000—a total loss of $296,000. Losses from inability to reach the best market, from the spoiling of produce, and from injury to horses and wagons were found to aggregate $221,000; from restricted ability to haul manure, $91,000 The total loss caused by bad roads was placed at $608,728.

The committee made the following deductions: On account of bad roads each farmer lost for the year $1.70 for every acre that he farmed; 13 cents every time he carried a ton of farm produce over one mile of bad roads; 9% of his total crop. He paid as much for bad roads as for labor; more than for feed for his stock; twenty-five times as much as for fertilizer. The total loss to the farmers in this district for the year from this cause would have bought all the corn produced in it, or all the wheat, or the oat crop twice over, or all but 10% of the potatoes, or all the barley, rye, flaxseed, timothy seed, hay, and forage combined. The losses would replace the farm implements or the cattle every three years, the horses every four years, and would pay off all the mortgages in the district in three years, with $100,000 to spare.

The farmers, moreover, were not the only losers from bad roads. The committee found that the worst sections of the roads they had to travel between their farms and market were within the city limits; that there were approximately 3,600 business houses in Minneapolis, employing 5,000 wagons, whose loss from bad roads was $910,000 for the year.

The combined loss of the farmers, merchants, and manufacturers for one year was $1,518,000. As there are about 3,000 miles of roads in the district, which could have been kept in good condition for $3000 a year, if properly constructed, in order to ascertain what amount could profitably be invested in good roads, the committee deducted this amount from the total loss, leaving $1,200,000. Capitalized at 4½%, or 5%, which is more than bonds would cost, the principal is $22,000,000. If this amount were invested in good highways at $7,000 a mile, the district would still break even on the investment.—Walter C. Tiffany, in *Review of Reviews.*

Three Suggestions for Good Concrete Pavements

JAMES O. HEYWORTH*

The most important features to be considered in concrete highway construction, in my opinion, are:

1—Do not use a top mortar finish, unless it is applied simultaneously with the foundation concrete.

2—Construct the pavement as monolithic as possible, avoiding blocking it off into small units. I consider a small unit less than 100 sq. yds. and suggest that 100 sq. yds. be considered a minimum. Would recommend making the units, 1,000 to 3,000 sq. yds. or more.

3—Do not make pavement too narrow and thereby force vehicles to travel over the same part of the pavement, forming ruts, but provide a good liberal margin to act as a shoulder and thus prevent breaking off the sides of the pavement.

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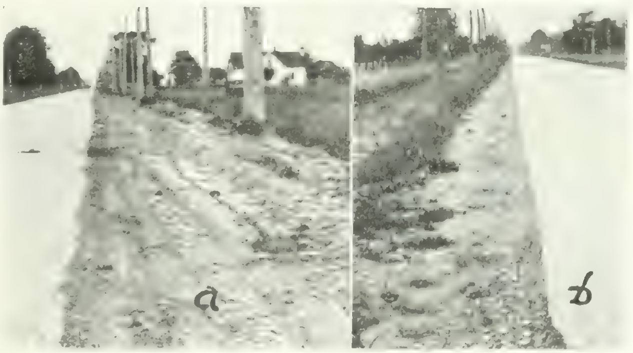
*Engineer and Contractor, Harrison Bldg., Chicago.

Road Building Kinks

Wayne County, Michigan

THE SHOULDERS



The construction of the shoulders is important. These two pictures were taken on Grand River avenue, Aug. 9. At *a* the work has not been done properly, or perhaps it is better to say it has not been finished. At *b* the condition of the shoulder is as it should be. To the right of the roadway at *a* it will be noticed that there is a pronounced comb of earth which has been left as the shoulders were shaped. This comb is at least 10″ higher than the edge of the concrete pavement. Such a condition it will readily be seen, will hold water next to the concrete, and always leave the possibility of water getting under the pavement there to freeze and cause trouble. In *b* the shoulders have been well smoothed off with a good slope, toward the ditches.

New Illinois Highway Law Centralizes Authority

The State of Illinois has a new highway law, a law which centralizes and simplifies future highway improvements in that state. In creating the organization for the administration of the new law there is a state highway commission consisting of three members appointed by the governor, one member for two years, one for four years and one for six years and on the expiration of these terms, the appointments will be for six years each. These highway commissioners are to give their time exclusively to their official duties, to have a salary of $3,500 a year with traveling expenses, clerk hire, etc. The law also provides for a chief state highway engineer and an assistant state highway engineer at salaries of $4,000 and $2,500 a year, respectively, each to hold office for six years. The engineer and the assistant are to be administrative and technical agents of the state highway commission and subject to the orders of the commission.

The law also provides that in each and every county of the state, there shall be a county superintendent of highways. Names of desirable candidates for this office are to be presented by the county board to the state highway commission within 90 days after the new act became effective, and by competitive examination the state commissioners are to determine which of the 3 to 5 candidates are eligible for the position, and the county board must appoint one of the eligible persons. The term of office of each superintendent of highways is 6 years, the salary to be fixed and paid by the county board. The county superintendents are subject to the rules and regulations of the state commission and are within their own counties to act as deputies under the chief state highway engineer.

In the matter of "state aid," the law provides in substance as follows:

State Aid Authorized. Public highways, or sections thereof, including bridges therein, may be laid out, improved, or constructed at the joint expense of the state and any county within the state as hereinafter provided. In such case the state shall contribute one-half the expense thereof and the county, or counties, through which the said highway or portion thereof passes shall contribute the remaining one-half. Such highways hereinafter known as "State Aid Roads" may be laid out, constructed or improved in the manner hereinafter directed: Provided, however, that no road or part thereof lying within the corporate limits of any city or village within this state shall be improved or constructed with state aid.

At their next regular or special meeting following the passage of this Act it shall be the duty of the supervisors in counties under township organization, or the board of county commissioners in counties not under township organization, to designate those public highways within their respective counties that shall come under the provisions of this Act. The highways to be designated by the county boards shall be as nearly as possible those highways connecting the principal cities and trading points in each county with each other; and also with the principal cities and trading points in other counties.

Such highways shall not include any portion of a public highway within the corporate limits of any city or village; nor shall the total mileage of such highways in any county exceed, in counties of the first class, more than 15% of the total public road mileage of that county; nor exceed 20% of the public road mileage in counties of the second class, and shall not exceed 25% of the public road mileage in counties of the third class. By public roads it is understood to mean all public roads within the state except those within the limits of incorporated cities and villages; the public road mileage of the counties to be that as determined and published by the State Highway Commission.

The county boards shall indicate the highways selected as aforesaid by marking them upon some map which shows the public roads and section lines in the county.

After the county boards have so selected the highways within their respective counties as aforesaid, and indicated the same on a map of the county, it shall be the duty of the county clerk immediately to forward said map, with his signature thereon attesting to the validity of the same, to the State Highway Commission. The State Highway Commission shall examine the map with the roads located thereon, and if the roads selected in one county do not connect with the roads selected in another county to make convenient through roads between the various cities and trading points of the different counties, the State Highway Commission shall make such changes as will best serve to make the most direct routes between such cities and trading points of the different counties, and return to the county clerks the maps with the corrections shown thereon.

State Commission Decides

If in the judgment of the State Highway Commission it becomes necessary to re-locate the routes as selected by the county board for state highways in any county, the State Highway Commission may notify the respective boards who shall, at their special meeting when they are selceting the state highways, appoint a committee not to exceed five in number, who shall, if they choose, appear before the State Highway Commission, who shall give hearings on the relocation of the routes as first selected by the county boards. After taking into consideration the information thus presented by these special committees, the State Highway Commission shall then proceed to indicate the routes along which state aid roads may be constructed, as hereinafter provided. The highways selected by the county boards and shown on the maps as revised by the State Highway Commission, shall be the highways to which the provisions of this Act shall apply, and they shall not apply to any other public highways. After the county map has been finally corrected by the State Highway Commission, a copy shall be returned to the county clerk and a copy retained by the State Highway Commission.

The county clerk shall enter the map returned to him among his official records, and no changes in the routes indicated thereon shall be made, except by a vote of the county board and with the approval of the State Highway Commission, as hereinafter indicated; and no changes whatever shall be made in the routes of such highways prior to three years after the filing of the first map thereof, except that in the event the routes as first selected and shown do not total a mileage equal to the percentage allowed for that county, additional roads may be added until the total precentage is equaled.

If any county board shall fail within six months after the passage of this Act to forward to the State Highway Commission a map showing the routes selected for state aid roads, then the State Highway Commission may make such selection itself from the best information that may be available, and a copy of such map with the roads selected shall be sent to the county clerk of those counties whose boards have not made a selection within the six months as herein provided, which fact shall be indicated on the map submitted by the State Highway Commission; and it shall be the duty of the county clerk to file such map among his records.

The improvement of the system of state highways as herein provided shall be carried on as follows: From such appropriations as the General Assembly may from time to time make for the purpose of carrying out the provisions of this Act, there shall be allotted by the State Highway Commission each year for each county an amount that shall bear the same ratio to the total appropriation for that year that the total amount levied in each county for roads and bridges bears to the total amount levied in the state for roads and bridges, as determined from the published reports of the Auditor of Public Accounts from the last year so reported; Provided, that to counties, in which more than 40 per cent of the total amount appropriated by the General Assembly for building roads is collected, including any amount collected for automobile and kindred licenses, and devoted to road building by such appropriation, there shall be allotted, under the provisions hereof, an amount equal to 25% of the amount so collected in such county.

One Reason Why the Builder Boosts Concrete

When a contractor has been operating in a city for a good many years the buildings which he has put up should stand as a monument to his work. There was probably never a contractor yet who didn't regret the destruction by fire of any building that he had built. For he likes, later in life, to point to what he has done. And what man would want to call attention to an ash heap or a blackened cellar hole filled with charred timber? Concrete construction is fireproof and when a builder puts cement, sand and stone together honestly and in a sincere endeavor to put up good work, he knows that he leaves behind him a monument that will outlive him, and one which can always be pointed out with pride. Sub-consciously, every builder turns to concrete as the ultimate material and uses it at every point possible.

Road Building Results

Wayne County Michigan

SOME NOTES ON GRAND RIVER ROAD

The views to the left and those to the right were taken on Grand River ave., Aug. 9, 1913. The macadam road shown in Fig. 1 was built in 1907 and built just as well as the County Road Commissioners knew how to build a tar macadam road. This road has been resurfaced over most of its area 4 times since its construction and this is the piece of roadway which Commissioner Hines refers to so strikingly as the one which the county could not afford to have even if it were laid free of cost, providing the county were obliged to maintain it for five years. The maintenance cost in five or six years is equal to the cost of a concrete road which immediately adjoins it on the northwest and which has been in use since 1909. The piece of concrete built in 1909 by the County Road Commissioners is not by any means a fair example of what is now being done with concrete by Wayne county. The surface is rather wavy, the joints are not made so well as they are made now with steel plates, and the surface has numerous patches of tar, but in its fifth year it is a cheap road, has cost very little to maintain and is in striking contrast to macadam roads of cheap first cost but of high ultimate cost.

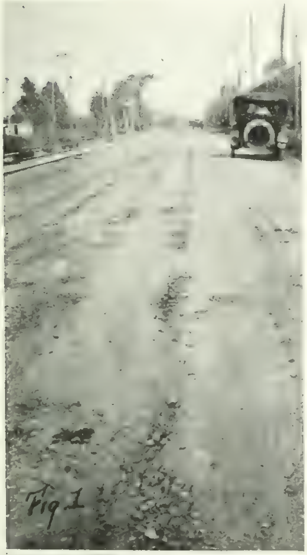


Fig. 1

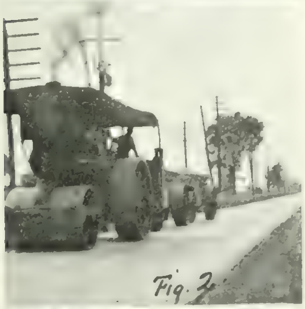


Fig. 2

Fig. 3

In Fig. 2 a road engine is seen hauling crushed stone over the concrete roadway on Grand River to get it to the scene of operations in Fig. 3, where the macadam is being patched.

Figs. 4 and 5 are typical concrete surfaces. These pictures were taken on Grand River avenue on the part of the road built in 1911. The upper picture shows a girl on roller skates who finds the roadway smooth and easy traveling. Fig. 5 shows several spots of tar. The county road commissioners go over all the concrete surface once a year employing a maintenance gang consisting of five men and a team. The team hauls a wagon of sand and behind it is drawn a tar kettle. Wherever the heat of the summer before has squeezed the asphalt filler out of the joints, the joints are cleaned and refilled, and whenever the maintenance gang finds a hole in the concrete, though it may be no bigger than the end of your thumb, a little tar is poured in and sand sprinkled on. It is perfectly natural that in the repair of these spots that the workmen should pour on a little more tar than is needed, and as they are not instructed to carry a cloth along to wipe off the surplus from the pouring pot, the tar is sometimes dropped where it is not needed. Therefore, a person entirely ignorant of these methods of road maintenance, traveling over a concrete surface which has been down three or four years, might see what he believed to be quite a few tar spots and if of a cynical turn of mind, call them all patches. Yet when it is considered how thoroughly this maintenance work is conducted and how each small hole is filled before it gets to be a big hole and how frequently tar is dropped where it is not really needed, and the fact that five men and a team can repair a mile a day, the maintenance is really not a serious matter.

Fig 6 shows a bad spot in the concrete and the picture does not show how bad it is, although the two very black spots are not holes in the concrete, they are holes in the photographic film. The trouble with this photograph is that it is not a very strong print and doesn't show up the irregularity of the surface. This was a contract job on Grand River avenue put down in 1910. In one place for a distance of about 300′ some un-

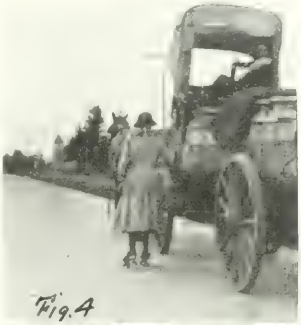


Fig. 4

Fig. 5

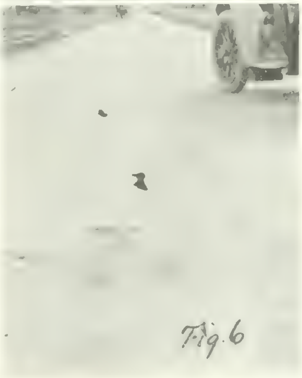


Fig. 6

usually bad material must have gone into the work because the concrete is worn rather rough. This much of the surface was given a thorough bituminous coating with a sand application and the condition is greatly improved. In any ordinary surroundings it would be considered a good stretch of highway, but in Wayne County, lying as a short stretch on Grand River avenue where there are 11 miles of concrete, it looks rather bad.

Two Course Concrete Pavement Work

In a communication on top course work on concrete floors in the *Engineering Record,* Charles H. Johnson, Supt., Public Works Dept., Guantanmo, Cuba, writes in part as follows:

"From personal observation of several hundred jobs I think that most, if not all, of the cases of the top coat separating from the base are caused by putting in the base too dry, allowing the base to set before applying the top, getting sand or other foreign matter on the base before applying the top, thus ruining the bond between the two layers, and finally making a sand joint in the base and not cutting the top through.

"The writer laid about 3,500 lin. ft. of concrete road from 8 to 12 ft. wide with 1:3:6 base and 1:2 sand top, and had absolutely no trouble with it. This was laid in sections 30′ long, with a 1-in. cypress expansion strip every 30′. Six months after laying there was no sign whatever of any separation between base and top.

On this job the base was laid very wet and put into place with a shovel, no tamping whatever being done. The top was often laid not more than fifteen minutes after the base was placed, and was also very wet. It was floated with a wooden float as soon as possible and then covered with 1 or 2 in. of sand, which was left on for at least a week, and frequently wet."

Provide Runways for Gophers

Gophers are costing the county a lot of money, and officials are figuring on some method of getting rid of them. The gophers dig under the county roads and the weight of traffic on top causes the roadbed to sink, and it is costly work making repairs. The matter of putting out poison for them is now being discussed. A suggestion has been made that drain pipes, if run under the paving at intervals, might relieve the situation, as it seems that the gophers dig the holes beneath the paving so that they can get across the road without going over the surface. A good roads publication recently said that the plan of putting drain pipes beneath the surface at intervals had largely abated the trouble in places where it had been tried, and this may be given a test on some of the new roads now being built in the county. —*El Paso* (Tex.) *Herald.*

Wisconsin's Concrete Roads

BY A. R. HIRST*

The experience of the State Highway Commission of Wisconsin with concrete construction does not extend very far back, the first road having been started in July, 1912, and about 9 mi. of concrete road were built in that year. The mixture was 1:2:4, the joint spacing 25′ to 35′, and the thickness 8″ in the center and 6″ on the sides, the subgrade being flat. One or two roads were built with a thickness of 7″ in the center and 5″ at the side, with a joint spacing of 35′.

The road built in 1912 cost, exclusive of grading and culvert work, about $1.00 per sq. yd. on the average. Owing to the fact that dirty material was used on part of this work, the results have not been entirely satisfactory, but none of the roads can be called a complete failure, and several of them are in very good condition. *Practically all of the construction was with unwashed gravel, and our experience last year taught us that unwashed gravel could not be used except in exceptional cases, and this year all gravel is being screened, and washed where necessary, separated into fine aggregate and coarse aggregate, and re-mixed as it goes into the road."*[1]

This year's specifications call for 1 part cement, 2 parts sand and 3½ parts coarse aggregate. The thickness is 8″ in the center and 6″ at the side, subgrade is flat, and the joint spacing is 35′. With the higher price of cement and the richer mixtures, the concrete roads built in Wisconsin this year will probably average about $1.15 per sq. yd. About 40 miles will be built.

We believe that the concrete road has a great field before it, but several points as to its construction have not been settled to our complete satisfaction. Joints of all types have given serious dissatisfaction. We believe that the advance will be along the line of minimizing the number of joints, and believe that ultimately a joint spacing of between 50′ and 100′ will be found to be sufficient, and that probably the joints will consist of some expansible material of a very small thickness.

By far the greater part of our mileage has been built with Baker joints used with two 1/16 in. thickness of asbestos felt, though some Cary Elastite is now being used. This form of joint is giving satisfaction where properly installed, but it has been almost impossible to get uniform installation, many of the plates being high or low, both of which are very objectionable. Short stretches have been built without steel protected joints, the joints being ⅜″ wide and filled with pitch or asphalt. On several short sections ⅞″ soft plank have been used for joints and left in, and these so far have given excellent satisfaction.

The character, spacing, width and protection of joints in the concrete are our most serious problem, and we have not as yet reached a satisfactory conclusion as to what is best in this regard.

It is believed that a mixture of 1:2:3½ is sufficiently rich if the aggregate is sized properly and is clean. We are convinced from experience that the flat base is the proper one. We are doubtful as to the thickness required, and believe that we are erring on the side of too great a thickness, and that experience will show that a considerably thinner concrete road is ample.

We have used the one course construction entirely, and practically all of gravel. We do not favor limestone concrete unless the limestone is extraordinarily hard, but have used crushed granite, and expect to use it to a greater extent in future years.

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*State Highway Engineer

[1] Italics are ours.—Editors.

Contraction and Expansion of Cement and Concrete

Dr. P. Rohland, in a recent issue of *Mitteilungen der Centralstelle,* has summarized the phenomena of expansion and contraction of cement and concrete as follows: If concrete and reinforced concrete set in the air, contraction takes place; if they set under water, expansion takes place. The latter is true if concrete sets in very damp air. Mixing more sand, or else adding hydroscopic salts decreases contraction. Another method to avoid excessive contraction is to cover the concrete with wet cloths.

If cement is mixed with water, elements in the colloidal state separate, which absorb water and lead to an increase in volume, accompanied by a slight lowering in temperature. As the cement begins to set, the volume gradually decreases, while the temperature increases. The cause of this decrease in volume and increase of temperature is the sudden coagulation of the colloidial elements in the cement which occurs with separation of water.

We have, then, two distinct steps: 1. Absorption of water with increase of volume and decrease of temperature; 2. Separation of water with decrease of volume and increase of temperature. It must be mentioned that the increase of volume in the first period is greater than the decrease in the second period. At the end of the setting process in cement and concrete a considerable decrease of volume takes place, for which allowances must be made, especially if the concrete sets in dry air.

United States Government Experimental Road

(Continued from page 103)

of the transverse cracks in the pavement occurred as a continuation of a crack in the gutter. Nowhere did a new crack form extending through the pavement and gutter. A piece of tar roofing paper was placed alongside the edge of the gutter so as to prevent any bond whatever between the pavement and gutter, during the construction of the section, 700 ft. in length, built in the spring of 1913, and the cracks in the gutter did not, in any manner, influence the location of the cracks in the pavement.

The concrete work was not carried on using 3 shifts of laborers as was proposed; the joint at the end of each day's work was made as specified.

Measurements have been taken along the pavement from time to time, but they have not been tabulated in such a manner as to justify the drawing of definite conclusions.

Each carload of cement used in the work was tested and conformed to specification.

A section of the concrete pavement was treated, during May, 1913, with a variety of bituminous materials in an attempt to ascertain whether or not a bituminous carpet coat can be maintained on a concrete pavement.

A section 50′ in length was given an application of crude water gas tar at the rate of about 1/10 gal. per sq. yd. No chips or sand were applied as the tar soaked into the pavement in a few hours. The pavement is stained a dark brown and while I do not know that this treatment will add any to the durability of the road, it seems to be the solution of the problem of staining the pavement.

The accompanying illustrations show very well the method of conducting the work. The mixing outfit shown laid on an average of 50 lin. ft. of pavement, 20′ wide, per hr. Cost data are shown in 10 tables.

TABLE I—[illegible]

Labor:	
Superintendent	[illegible]
Foreman	[illegible]
Rodman	[illegible]
[illegible]	[illegible]
Carpenter	3.50 per day of 8 hrs.
Laborer	[illegible]
Team	[illegible]
Materials f. o. b. nearest siding:	
Sand	[illegible]
Gravel (for use in concrete gutter and base)	85 cts. per ton
Gravel (for use in concrete pavement)	95 cts. per ton
Crushed limestone	$1.10 per ton
[illegible]	[illegible]
Cement	1.51 per bbl.
Contract price for unloading and hauling materials from siding to work (average haul 3,100′):	
Sand and gravel	[illegible]
Crushed stone	45 cts. per ton
Cement	10 cts. per bbl.
Machinery:	
Concrete mixer	$10.00 per day
Roller	[illegible]

TABLE II—EXPERIMENTS NOS. 1 AND 2—BITUMINOUS CONCRETE

Quantities of Materials and Cost Data

Description: Experiment Nos.	1 A	1 B	2 A	B
Pavement Materials:	Topeka Specification Limestone Aggregate	Topeka Specification Trap Aggregate	Dist of Columbia Specification Limestone Aggregate	Dist. of Columbia Specification Trap Aggregate
Length of Section (ft.)	334	301	284	346
Area of Section (sq. yd.)	762	736	631	[illegible]
Quantities of Materials:				
Base:				
Gravel (cu. yds. per sq. yd.)	0.150	0.150	0.150	[illegible]
Sand (cu. yds. per sq. yd.)	0.065	0.065	0.065	0.065
Cement (bbls. per sq. yd.)	0.145	0.145	0.145	0.145
Pavement:				
Coarse aggregate (cu. yds. per sq. yd.)	0.644	0.0688	0.0464	0.0462
Sand (cu. yds. per sq. yd.)	....	....	0.0244	0.0244
Limestone dust (cu. yds. per sq. yd.)	0.005	0.0066	0.005	0.005
Bituminous material (lbs. per sq. yd.)	16.90	18.70	12.00	13.60
Bituminous seal coat (gals. per sq. yd.)	....	....	0.51	0.51
Cement on surface (bbls. per sq. yd.)	0.003	0.003	....	....
Chips (cu. yds. per sq. yd.)	....	....	0.005	[illegible]
Cost Data (Cents per sq. yd.)				
Base:				
Gravel	27.30	27.30	27.30	27.30
Chips in seal coat	....	....	1.21	1.21
Sand	9.30	9.30	9.30	9.30
Cement	23.40	23.40	23.40	23.40
Mixing and Laying	17.45	17.45	17.45	17.45
Pavement:				
Bituminous concrete at plant (estimated)	43.00	43.00	43.00	43.00
Hauling to road	19.00	19.00	19.00	19.00
Laying and rolling	5.89	5.89	5.89	5.89
Bitumen in seal coat	....	....	7.19	7.19
Labor, applying seal coat	....	....	1.11	1.11
Cement on surface	0.48	0.48	....	....
General:				
Preparing subgrade	21.44	21.44	21.44	21.44
Superintendence	8.01	8.01	8.01	8.01
General expense	4.54	4.54	4.54	4.54
Miscellaneous	6.81	6.81	6.81	6.81
Total Cost				
Cents per sq. yd.	186.62	186.62	[illegible]	[illegible]
Entire section	1,422.04	1,373.52	[illegible]	[illegible]

Mortar shoulder 2″ x 6″, 1315′ @ 4.26 cts. per lineal ft., $46.08
Total cost of Experiments Nos. 1 and 2, $5,580.74
Average cost per sq. yd., $1.925

TABLE III—EXPERIMENT NO. 3—PLAIN AND OIL-CEMENT CONCRETE

Quantities of materials and cost data
(Surface coated with bituminous materials)

Section:	1—Plain Concrete		2—Oil-Cement Concrete	
Description:	Gravel	Limestone	Gravel	Limestone
Length of section (ft.)	677	576	361	[illegible]
Area of section (sq. yds.)	1,532	[illegible]	823	518
Quantities of Materials:				
Coarse aggregate (cu. yds. per sq. yd.)	0.123	0.123	0.123	[illegible]
Sand (cu. yds. per sq. yd.)	0.069	0.069	0.069	0.069
Cement (bbls. per sq. yd.)	0.255	0.255	0.255	0.255
Oil (gal. per sq. yd.)	....	....	0.638	[illegible]
Cost Data (cents per sq. yd.):				
Preparing subgrade	21.44	21.44	21.44	[illegible]
Coarse aggregate	25.10	25.10	25.10	[illegible]
Sand	9.87	9.87	9.87	[illegible]
Cement	41.15	41.15	41.15	[illegible]
Oil	....	....	[illegible]	[illegible]
Mixing and laying	21.31	21.31	[illegible]	[illegible]
Protection after laying	1.62	1.62	[illegible]	1.62
Superintendence	8.01	8.01	[illegible]	8.01
General expense	4.54	4.54	[illegible]	4.54
Miscellaneous	6.81	6.81	6.81	6.81
Total Cost:				
Cents (per sq. yd.)	139.85	[illegible]	147.66	[illegible]
Entire section	2,142.50	[illegible]	1,215.24	[illegible]

Grand total cost of Experiment No. 3, [illegible] ...... [illegible]
Surface treatment* 471.95
[illegible]
Average cost per sq. yd. $1,549.00

*See detailed Cost Data, Table IV

TABLE V.—EXPERIMENT NO. 4—OIL-CEMENT CONCRETE

Quantities of Materials and cost data

Description:			
Coarse Aggregate	Gravel	Limestone	Trap
Length of section (ft.)	[illegible]	[illegible]	[illegible]
Area of section (sq. yd.)	[illegible]	[illegible]	[illegible]
Quantities of Materials:			
Coarse aggregate (cu. yds. per sq. yd.)	0.123	0.123	0.123
Sand (cu. yds. per sq. yd.)	0.069	0.069	0.069
Cement (bbls. per sq. yd.)	[illegible]	[illegible]	[illegible]
Oil (gal. per sq. yd.)	0.638	0.638	0.638
Cost Data (cents per sq. yd.):			
Preparing subgrade	[illegible]	21.44	[illegible]
Coarse aggregate	[illegible]	[illegible]	[illegible]
Sand	[illegible]	[illegible]	[illegible]
Cement	[illegible]	41.15	[illegible]
Oil	[illegible]	[illegible]	[illegible]
Mixing and laying	22.06	22.06	22.06
Protection after laying	1.62	1.62	1.62
Superintendence	8.01	8.01	8.01
General expense	4.54	4.54	4.54
Miscellaneous	[illegible]	[illegible]	[illegible]
Total Cost:			
Cents per sq. yd.	[illegible]	[illegible]	[illegible]
Entire section	908.11	714.13	998.55

Total cost of Experiment No. 4 ...... $2,620.79
Average cost per sq. yd. $1.502

TABLE IV—BITUMINOUS SURFACE COATS

[illegible]	[illegible]	Area of Section (sq. yds.)	Rate of application: Bituminous material (gal. per sq. yd.) Paint coat	Rate of application: Bituminous material (gal. per sq. yd.) Carpet coat	Rate of application: Chips (cu. yd. per sq. yd.)	Cost data (cents per sq. yd.): Bituminous material Paint coat	Cost data (cents per sq. yd.): Bituminous material Carpet coat	Chips	Labor of application	Total	Cost of Entire Section
[illegible]	[illegible]	912	...	0.33	0.01	...	4.09	2.43	3.07	[illegible]	$87.46
[illegible]	[illegible]	[illegible]	...	0.33	0.01	...	3.27	2.43	3.07	[illegible]	79.19
[illegible]	[illegible]	281	0.10	0.50	0.01	[illegible]	[illegible]	2.43	3.79	[illegible]	40.94
Ugite No. 1C	Special Bermudez	[illegible]	0.20	0.50	0.01	1.74	[illegible]	[illegible]	3.79	[illegible]	43.38
[illegible]	[illegible]	571	0.20	0.40	0.01	1.74	[illegible]	2.43	3.79	12.56	71.72
None	Special Bermudez	[illegible]	...	0.50	0.01	...	[illegible]	2.43	3.07	12.55	113.83
None	Texaco Road Asphalt	[illegible]	...	0.50	0.01	...	[illegible]	2.43	3.07	11.25	35.43
											$471.95

TABLE VI—EXPERIMENT NO. 5—CEMENT CONCRETE

Quantities of Materials and Cost Data

Description:			
Coarse Aggregate	Gravel	Limestone	Trap
Length of section (ft.)	425	[illegible]	300
Area of section (sq. yds.)	956	1,4[illegible]4	633
Quantities of Materials:			
Coarse aggregate (cu. yds. per sq. yd.)	0.123	0.123	0.123
Sand (cu. yds. per sq. yd.)	0.069	0.069	0.069
Cement (bbls. per sq. yd.)	0.255	0.255	0.255
Cost Data (cents per sq. yd.):			
Preparing subgrade	21.44	21.44	21.44
Coarse aggregate	25.10	28.10	29.89
Sand	9.87	9.87	9.87
Cement	41.15	41.15	41.15
Mixing and laying	21.31	21.31	21.31
Protection after laying	1.62	1.62	1.62
Superintendence	8.01	8.01	8.01
General expense	4.54	4.54	4.54
Miscellaneous	6.81	6.81	6.81
Total Cost:			
Cents per sq. yd.	139.85	142.85	144.64
Entire section	1,336.97	2,034.18	915.57
Grand total cost of Experiment No. 5		$4,286.72	
Average cost per sq. yd.		$1.422	

TABLE VII—EXPERIMENT NO. 6—BRICK PAVEMENT

Quantities of Materials and Cost Data

Description:	
Length of section (ft.)	[illegible]
Area of section (sq. yds.)	2,0[illegible]
Quantities of Materials:	
Base:	
Gravel (cu. yds. per sq. yd.)	0.150
Sand (cu. yds. per sq. yd.)	0.065
Cement (bbls. per sq. yd.)	0.145
Pavement:	
Sand cushion (cu. yds. per sq. yd.)	[illegible]
Brick (number per sq. yd.)	[illegible]
Sand in grout (cu. yds. per sq. yd.)	0.005
Cement in grout (bbls. per sq. yd.)	[illegible]
Cost Data (cents per sq. yd.):	
Base:	
Gravel	[illegible]
Sand	[illegible]
Cement	[illegible]
Mixing and laying	17.45
Pavement:	
Sand in sand cushion	[illegible]
Preparing sand cushion	3.66
Brick	80.00
Unloading and piling brick from car	15.23
Hauling and piling brick by roadside	11.18
Laying brick	5.20
Rolling brick	1.76
Sand in grout	0.80
Cement in grout	5.08
Grouting	2.96
Protection	1.57
General:	
Preparing subgrade	21.44
Superintendence	[illegible]
General expense	4.54
Miscellaneous	6.81
Total Cost	
Cost per sq. yd.	258.21
Total section	[illegible],306.22
Concrete shoulder, 6″ x 8″, 1,350 lin. ft. at 10.12 cts. per lin. ft.	136.59
Expansion joint 1,900 lin. ft. at 3.84 cts. per lin. ft.	73.05
Total	[illegible]
Average cost per sq. yd.	$2.683

TABLE VIII—MISCELLANEOUS WORK

Building catch basin	19.02
Removing trees (10 in front of Mr. [illegible])	95.87
Removing old cobble gutter, 3,310 lin. ft.	79.61
Broken stone shoulder (Sta. 58+50 to [illegible])	*62.50

*Stone secured for excavation

TABLE IX—FRENCH DRAIN

Length		8,648′
Labor:		
Foreman	$140.87	
Men	846.87	
Team	[illegible]	1,096.30
Materials:		
Tile, 8,648′ at 6.7 cts. per ft.	579.42	
*Stone for filling trench	369.52	948.94
		$2,045.24
Per lin. ft.		[illegible]

*A considerable quantity of stone for filling the trench was secured from the old macadam road. The labor necessary to secure this stone was so much that the drain would have cost but little more had fresh stone been purchased.

TABLE X—CONCRETE GUTTER

Total length	5,631ft.
Quantities of Materials per lin. ft. of gutter:	
Cement	0.101 bbls.
Sand	0.029 cu. yd.
Gravel	0.050 cu. yd.
Cost data, cts., per lin. ft.:	
Cement	$16.06
Sand	4.38
Gravel	[illegible]
Forms	1.81
Foreman	[illegible]
Carpenter and helper	2.05
Finisher and helper	3.24
Labor	16.49
Total	[illegible]
Total cost of gutter	$3,070.02

Traffic Counts and a Standard Traffic Unit

In a paper on road maintenance in a bulletin recently published by the United States Office of Public Roads, Dr. L. I. Hewes, chief of economics and maintenance, mentions the importance of traffic count and the recognition of a unit of traffic. He says:

It will be more and more necessary in the future to study the service of various roads by accurate traffic censuses. From the investigations that have already been made it appears that for any civil sub-division a relatively small percentage of all the roads carry nearly all the travel. In France a traffic unit called the "collar" is used. The "collar" is a single horse harnessed to a vehicle, and all other traffic is reduced to "collars," including automobile traffic. The "collar" has not been adopted in the United States as a traffic unit. It is unfortunate, moreover, that no agreement exists among road men at present as to the detailed method of measuring traffic. Traffic censuses were taken in Illinois in 1906-7, in New York in 1909, and in Massachusetts in 1909 and 1912. These censuses counted the travel, but no common unit is yet available for reducing such traffic data; moreover, the useful tonnage is a most important item from an economic standpoint, and it is seldom counted.

It is well established that an improved road draws to itself increased traffic. To determine the future use of roads, it will be necessary not only to know the travel passing over the road before improvement, but also to know the increase of travel which is likely to be diverted to the road when it becomes improved. It is undeniable that travel upon roads in general is rapidly increasing numerically in tonnage and in mileage of travel radius. Preliminary study is clearly necessary, therefore, to enable road men properly to relate the first construction costs to probable maintenance charges. There should be an ample "factor of safety" in road design to allow for increased service.

The longer a concrete building stands, the harder it is to tear it down. In one case, where 5,000 sq. ft. of floors were torn down, 32 men worked 5 weeks, costing about $1,500. In another case, the building had originally cost $35,000, and it cost $5,000 to tear it down; the value of the steel recovered was about $750.—*Industrial Management*

Some New York State Concrete Roads

(Continued from page 109)

issue,[2] to specifications under which concrete highway contracts were let. The paragraph requiring rolling, in these specifications, has been entirely disregarded, as it was deemed impracticable to use a roller in the work. An examination of these specifications seems to indicate that they are written as a sort of blanket set of specifications, supposed to cover everything, various features to be picked out on individual contracts. There seems to be a reasonable opportunity for misunderstanding as to the kinds and qualities of materials required. Some paragraphs from these specifications[3] as to the materials and the methods are quoted.

Specifications

From page 33:

Concrete—Concrete will be classified as follows: First-class, second-class, third-class.

First-class concrete shall be made of 1 part Portland cement, 2 parts clean sand or crusher dust, resulting from the breaking of hard trap, hard sandstone, granite or gneiss, and 4 parts of crushed stone, all measured in loose bulk in boxes or forms of known capacity satisfactory to the Engineer.

Crushed stone for first-class concrete shall be trap, granite or gneiss, satisfactory to the Commission.

Second-class concrete shall be made of 1 part of Portland cement, 2½ parts of clean, approved sand or crusher dust, and 5 parts of crushed stone or screened washed gravel if permitted by the Engineer, all measured in loose bulk in boxes or forms of known capacity satisfactory to the Engineer.

Third-class concrete shall be made of 1 part of Portland cement, 3 parts of clean, approved sand or crusher dust and 6 parts of crushed stone, all measured in loose bulk as aforesaid. The substitution of gravel for stone in concrete will not be permitted except in special cases under such conditions and requirements as the Commission may prescribe.

Boulders and fragments of rock may be embedded in third-class concrete. Each stone before being embedded or placed shall be thoroughly washed and soaked, to free it from all dirt. * * * *

From page 34:

Quality of Stone—Stone for concrete shall be of an approved kind and quality of rock and shall be free from soil, mud or dust. Soft stone shall not be used in making concrete. Crushed stone for first-class concrete shall be of the No. 2 size; for second-class concrete shall be of the No. 2 size, mixed with No. 3 size; and for third-class concrete shall be of No. 2 or No. 3 size.

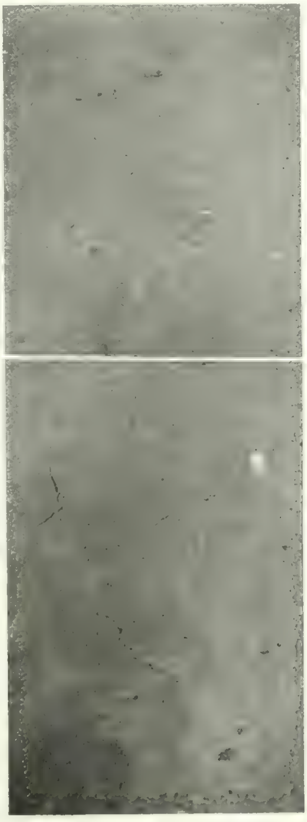
Sand—Sand, the particles of which shall not be greater than ⅛ of an inch in size, shall be clean, sharp, free from organic matter and not excessively fine, and shall be screened and washed if required. * * * *

From page 36:

Freezing— * * * Concrete work shall not be done during freezing weather. In warm weather concrete shall be covered with canvas, grass, weeds, or otherwise protected from the sun, and shall be wet down until thoroughly set.

From page 37:

Gravel Concrete — Gravel concrete when permitted, shall be used in such places and in such forms and dimensions as may be shown on the plans or as directed by the engineer. Before any gravel shall be used in concrete a sample, containing at least 1½ cu. ft., shall be taken by the contractor, in the presence of the engineer, and expressed to the division engineer for approval. *When gravel from an accepted source of supply does not continue to be satisfactory to the division engineer, the contractor will be required by the commission to secure satisfactory gravel elsewhere without extra compensation.*[4] Gravel concrete must in all respects conform to the specifications for stone concrete except as hereinafter stated.



Fig[illegible] and [illegible]—Freezing in Concrete [illegible]

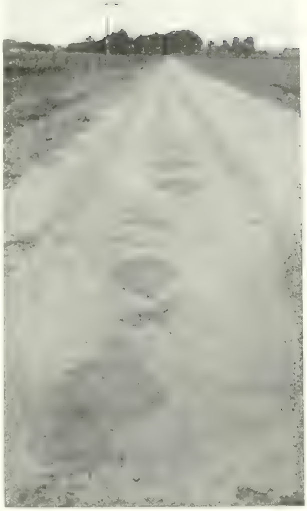


Fig. 19.—Wheel and Hoof Tracks in Freshly Laid Concrete Road After Being Patched

From page 38:

Per cent. of voids—If the portions of gravel, as taken from the bank contain between 45% and 55% of sand, it may be mixed directly with the cement, in the proportion of 1 part of cement to 6 parts of gravel; but if the percentage of sand is greater or less than the above mentioned limits, it shall be made to meet those requirements by the addition of the necessary amount of either sand or screened gravel, as the case may require, before the addition of the cement to the gravel.

Boulders—Material graded as boulders may be embedded in the concrete in the same manner as specified for stone in stone concrete, when used in retaining walls.

Sand—Sand, the particles of which shall not be greater than ¼″ in size, shall be clean, sharp, free from organic matter and not excessively fine. It shall be screened if required. Should dirty sand be delivered on the work, it shall be washed before using. Crusher dust screened to reject all particles over ¼″ in diameter may be used as a substitute for an equal bulk of sand. Shale sand or shale and limestone crusher dust must not be used. Samples of sand proposed for use must be submitted to the division engineer for approval before being used.

From "Concrete-Bituminous Top" we quote:

Bottom Course—The bottom course of this road shall be as shown on the plans when rolled in place and shall be formed of —— class concrete, —— inches thick.

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[2] Page 31

[3] Quotations are from specifications designated as "'A' State of New York Department of Highways Proposal and Specifications for Building the —— Highway in the County of —— . . . . Concrete Bituminous Top, 1913"

The specifications are in booklet form and together with the "Information for Bidders" and blank tables for "Proposal" occupy about 50 pages. The general specifications are arranged alphabetically, not in any sequence of operations. The general specifications from which the following is quoted are followed by the specifications: "Concrete-Bituminous Top"

[4] The italics are our [illegible]

Top Course—The top course of this road shall be approximately ¼" in thickness as shown on the plans when rolled in place, and shall be formed of bituminous material T. and H. O. and sand or screenings.

Concrete Bituminous Top Course

After the subgrade has been thoroughly rolled so that the surface conforms to a line parallel and at the proper depth below the grade line shown on the plans, second class concrete —— inches[5] thick shall be spread to the depth and cross section shown on the plans. * * * *

Or in lieu of compacting the concrete by rolling, as described above, if the Engineer so directs the concrete shall be laid wet and tamped in the usual manner.

Necessary transverse expansion joints must be provided by the contractor as directed by the engineer.[6]

In order to obtain a uniform surface, timbers shall be placed at the edges at such an elevation that when the surface is struck with a template it will give the proper crown and will be true and even with no depressions or irregularities.

Proofs of the foregoing were sent to Frederick S. Strong, division engineer at Syracuse, asking for suggestion and comment and we quote his comment as follows:

> Commenting on the contents of this article, it appears to me that your critic has fairly represented the facts in some particulars, but on the whole it is somewhat unjust because it will give the impression that the results of this type of construction have been disappointing or partial failure. As a matter of fact most roads of this type built in this division are entirely satisfactory and have been built according to the specification which your correspondent criticises.

It is sincerely hoped that the Editorial Foreword published at the beginning of this article and proof of which Mr. Strong had not seen when he wrote his comment on the article, may remove any idea of unjust criticism. We are particularly glad to note that "most roads of this type built in this division are entirely satisfactory and have been built according to the specification."

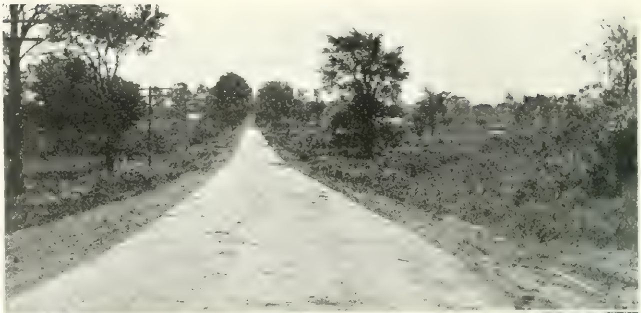

Fig. 11. [illegible] Road (No. 672)

View east from Sta. [illegible] bituminous top; photo made May 29, 1913, when the road was not completed throughout its length.

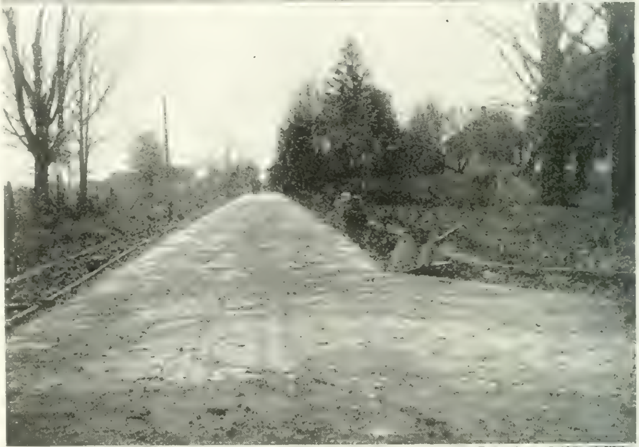

Fig. 12. [illegible] Road (No. 962) Built 1912-1913

View east from Sta. 222+70; Photo made Oct. 30, 1912, showing untreated concrete base.

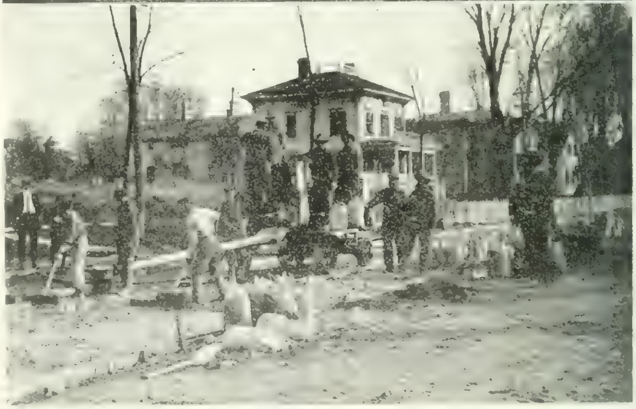

Fig. 13. [illegible] Road (No. 5676, Part 2), Hassam Construction, 1912

View at Sta. 44+75; Photo made Oct. 30, 1912, while road was under construction; grouting machine is at work.

An interesting development has arisen in connection with the use of bulk cement. At Sumner, Ill., the concrete products plant operated by Blood Bros. is located at some distance from the railroad siding. They have found it to be a decided economy to empty sacked cement into bins and to ship back the bundled sacks without delay. This has served both to save wear and tear on the sacks and to decrease the investment ordinarily tied up in sacks. Often credit has been given for sacks prior to the actual billing of the cement. They state that there has been an additional advantage due to the bulk cement caking to a less degree than the sacked cement. At the time of the Easter flood they had some sacked cement piled on a floor at the same level as their bin of bulk cement. The former absorbed considerable moisture and became lumpy, while the bulk cement at the same level was unharmed and not a single lump formed. The owners do not explain this, but merely state it as a fact.

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[5] [illegible] Above it is left blank. The major portion of this paragraph we do not quote. It was quoted in the Sept. issue 1912. It calls for rolling the concrete.—Editors.

[6] [illegible] expansion joint has been provided on state concrete roads.—Editors

The Construction of a New Jersey Concrete Road

The state of New Jersey has become interested in concrete road construction and the sample already in use is likely to mean more of this work. This is 4,800' long, from 14' to 18' wide, 6" thick with stone shoulders, concrete of 1:2:4 mix, cement, sand and crushed stone laid with a crown of ¼" to 1'. Transverse joints were put in every 30' filled with but one thickness of 3-ply tar paper. At some of the joints Baker plates were used. This road is known as Morris Turnpike, is between New Village and Stewartsville and was built on an old macadam road which was slightly scarified and well rolled. Three-in. land drain tile were put in 18" below the stone shoulder on each side. The concrete was surfaced after the passing of the template using wood floats and later roughening with a street broom. About half the length of this road has been surfaced with Dolarway, the rest of it is of plain concrete. F. W. Salmon, County Engineer of Warren County in which the road is built, writes us on August 16 that this road which was built in October, 1912, has a very few longitudinal cracks but otherwise is in perfect condition and practically no surface wear to be detected. This road was put down at the rate of about 300 lin. ft. per day. Its cost based on the area of the concrete was as follows:

New Jersey Road With Broomed Surface—Shoulders Not Built

Drains	6c per sq. yd.
Grading	11c per sq. yd.
Shoulders and ditches	.28c per sq. yd.
Concrete	95c per sq. yd.
Total	$1.40 per sq. yd.

Build Dips in Concrete Roads Instead of Culverts

An interesting development in concrete road construction is in Minnesota where, State Engineer George W. Cooley writes, dips in the roads have been made in some places instead of building culverts. This has been resorted to in extremely hilly sections, particularly along the Mississippi river, where valleys carry large deposits of rock and sand which close up culverts after nearly every heavy rain storm. Eng'r Cooley says that the maintenance of the roadway in the face of these conditions is much easier by adopting this method of taking care of flood water and that the public makes no objection to the dips which are usually paved with concrete to the outside of the gutters. The accompanying illustrations show a profile (Fig. 1) and cross-section (Fig. 2) of one of these dips as built in West Albany township, Wabasha county.

Of the concrete road construction generally Mr. Cooley writes:

> We have made the maximum distance between expansion joints 30' and in most cases are building the road in 25-ft. sections.
>
> We believe that a good trap rock or gravel aggregate furnishes the best quality of concrete for roadways and that the proportion of 1:4 works out very well. On roads which are not very heavily traveled and which we consider single track roads, we are improving by placing an 8-ft. width of concrete with 6' of macadam or gravel shoulder on each side; but on roads which receive considerable traffic and which might be classed as double track roads, we are building a 16-ft. width of concrete with 4' of gravel or macadam shoulder.

Wayne County Concrete Roads

(Continued from page [illegible])

and pebbles were used and steel plates at joints, cost was only $1.12 per sq. yd.

1913—Further work in progress.

Van Dyke Road: 1910—Length, 1 mi.; width, 15'; shoulders, 4' 6"; 2 courses—4", 1:2½:5 and 2", 1:2; washed sand and gravel used, asphalt felt joints; cost $1.027 per sq. yd.

1911—Length, 1 mi.; cost, $1.619 per sq. yd.

1912—Length, about 1¾ mi.

1913—Work in progress.

River Road: 1910—Length, about 4,000'; width, 15'; shoulders, 4'; 1 course, 6", 1:2:3, washed sand and gravel, asphalt felt joints; cost, $1.288 per sq. yd.

1911—Length about 14,500'; 1 course 1:1½:3 mix; washed material; steel plates and asphalt felt.

1912—Extended to nearly its present length of 10.78 mi.; subgrade flat, concrete 6" at edges, 7¾" in center.

1913—Road completed as shown on map.

Mt. Elliott Road: 1910—Length, about ¾ mi.; width, 12'; 2 courses—4", 1:2½:5 and 2", 1:3; asphalt felt joints; shoulders 5'; cost, $1.44 per sq. yd.

1911—Length, about ½ mi.; width, 18'; 1 course. 1:1½:3; steel joints, asphalt felt and washed material; shoulders, 3'; cost $1.658 per sq. yd.

1912—Length, about 2 mi.

1913—Work extended to what is shown on map.

Michigan Road: 1910—Length, 12,729'; width 18'; 1 course, 7½" (on a crowned subgrade) 1:2:4 mix (washed material); shoulders, 3'; cost, $1.31 per sq. yd.

1911—Extended to Wayne; widths, 16', 18' and 20'; 7" thick, 1 course, 1:1½:3 mix; cost, $1.676 per sq. yd.

1912—This year and in 1913 the road was completed to the county line beyond Denton as shown on map—total length, 22 mi.

Mack Road: 1910—Length, about 1,600'; width 15'; 1 course 6", 1:2:4 mix; built under contract at $1.347 per sq. yd. This work is not satisfactory.

1911—Extended to total length of .592 mi. at $1.75 per sq. yd.

Gratiot Road: 1910—Length, 6,000'; width 16'; 1 course, 7", 1:1½:3 mix; asphalt felt joints; (screened material —not washed); cost $1.089 per sq. yd.

1911—Extended to a total length of 3.23 mi. Same as 1910 work except that washed material was used, and steel plates at joints in 1 mi. of the work; cost, $1.66 per sq. yd. (long haul for materials).

Fort Road: 1910—Length, ½ mi.; width, 12'; 1 course, 6", 1:2:4 mix; laid on contract; cost, $1.317 per sq. yd. Work so unsatisfactory that commissioners refused to accept it until contractor put on, at his own expense, a bituminous sand coat.

1912—Extended by County Road Commissioners to a total length of 2.637 mi., 12' wide under the new specifications.

Eureka Road: 1910—Length, 1 mi.; width 12'; 6" thick; 1 course, 1:2:4 mix; cost, $1.287 per sq. yd.

1912—Extended to a total length of 4.135 mi. under the new specifications.

Jefferson Road: 1912—Length, 1.75 mi.; width, 18'; under new specifications.

1913—As shown on map.

Warren Road, 7-Mile Road, Huron River Drive are new roads under construction with concrete first this year.

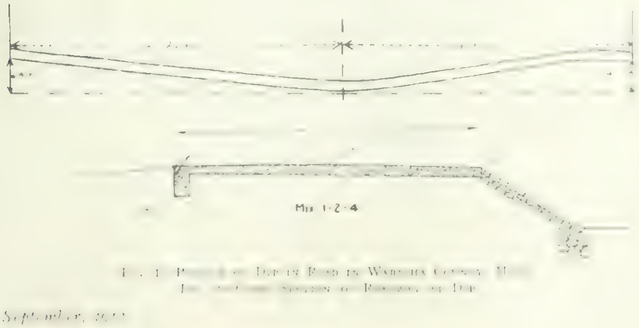

Fig. 1—Profile of Dip in Road in Wabasha County, Minn.
Fig. 2—Cross Section of Roadway at Dip

Concrete Paving in Kansas City—74 Miles in 1912

In 1907 Kansas City, Mo., put down its first concrete pavement, using a 1:3:5 mix 6″ thick, tamped and flushed to a true plane, at a cost under a 7-yr. guarantee of $1.23 per sq. yd. This was laid in a residence district which has gradually changed to business. Although of a lean mix with no expansion joint, no serious cracks have developed and there has been no need of repairs. This experiment was so satisfactory that by the first of the year 1913 the city had 7½ mi. of alleys paved with concrete.

One of the first street paving jobs with concrete in Kansas City was in the nature of a makeshift. It was expected in the fall of 1910 that Sixth street, Broadway to Bluff street, a thoroughfare connecting a railroad and warehouse district with a wholesale and retail district, taking heavy traffic would soon be widened, but a new pavement, even though a supposedly temporary one had to be provided. Concrete 36′ wide was used in a 1:2½:4½ mix, 6″ thick, using the old broken foundation, screened, for an aggregate. It was proposed to use this concrete pavement as a base for the future pavement when the street was widened. The pavement was laid in November, rush work before cold weather; covered with manure (temperature below freezing every night), and opened to traffic in two weeks. In the winter transverse cracks developed about every 125′ but have never given trouble. Frost also affected the surface to a depth of about ¼″. In eight months holes developed where road had insufficient mortar or where the old broken concrete aggregate had not been well mixed. Concrete surfacing was done on the west two blocks in 1912 and repairs were made again this year. The east end of the street where fresh stone was used for aggregate is in use with only the original concrete, worn to the appearance of terazzo, smooth yet giving good foothold.

The above is an abstract of a description of a poorly constructed concrete pavement, written by Clark R. Mandigo[1] in the *Engineering News*.[2] The pavement was laid as a makeshift with an idea of purely temporary use, employing very inferior materials and put down under adverse conditions. Mr. Mandigo says that the work is on a street which should not have been paved with concrete in any form. In 1911 the city laid 46,000 sq. yds. (3.3 mi.) of plain concrete pavement at an average cost of $1.23 per sq. yd. There was some 2-course work included in this, which cost $1.47 per sq. yd. In 1912, 237,000 sq. yds. (14.9 mi.) of concrete 6″ thick were laid in Kansas City. Mr. Mandigo predicts that the 1913 record will equal that of 1912.

The earliest pavements were laid without expansion joints. The 1911 and 1912 work has ½-in. transverse joints filled with asphalt, every 50′. It developed, according to Mr. Mandigo, that the earlier work seemed to be freer from longitudinal cracks and secondary transverse cracks than the later work with transverse joints and that it seemed logical to suppose that concrete occupies the most space when first laid in a wet mass, and that the expansion strains be disregarded and the temperature effects in contraction alone considered. So in the 1913 specifications, paper joints only, placed every 30′, are called for.[3] These specifications in their chief details follow:

Specification

Broken Stone—The broken stone shall be clean, hard limestone, with largest stones of such size as will pass a 2-in. ring and with all material that will pass a ½-in. screen removed. The stone must be free from dirt or any deleterious matter and must contain practically no soft, flat or elongated particles.

Proportions of Concrete—The Portland cement concrete shall be composed of one volume of cement, 2½ of sand and 4½ of clean, broken stone. All measurements are to be of the loose materials.

Mixing—Concrete must be mixed by a machine of a type that will insure accurate proportions of the ingredients, and be acceptable to the city engineer.

The materials shall be mixed wet enough to produce a concrete of such consistency that it will flush readily when tamped, but which can be handled without causing a separation of the coarse aggregate from the mortar, and which will not creep toward the curb or sag out of place when deposited and lightly tamped. After the addition of water the mixture shall be handled rapidly to the place of final deposit. Under no circumstances shall concrete be used that has partially hardened.

Depositing Concrete—The concrete must be taken from the machine in such manner as will insure against loss of mortar, and deposited to such depth that when tamped and properly finished the pavement shall have a thickness of 6 in., and the upper surface shall be true and uniform.

To assist in bringing the street surface to correct grade and crown, the contractor shall drive stakes at center and quarter points of roadway at intervals not greater than 25 ft. These stakes shall be firmly driven with their tops at the elevation of the finished pavement, or, if preferred, with a well defined mark at this elevation, so that during the laying of the concrete it will be possible to stretch a line from a stake to the one in advance for the purpose of determining any irregularities. When the stakes in front have been reached, the set just passed shall be removed and the holes carefully filled.

The concrete must be deposited in strips transverse to the roadway, and when interruptions occur of such length as to permit the setting of concrete, the pavement must be finished against a board set vertically and at right angles to the street, so that the depositing of concrete may be resumed without disturbing that already in place.

Finishing—The pavement shall be finished by thorough hand tamping, until the mortar flushes freely to the surface, then lightly tamped and broomed with fiber push broom—the final markings to have a neat and uniform appearance transverse to the roadway.

Cleavage Planes—At intervals of approximately 30′, transverse cleavage planes shall be constructed by placing a board in a vertical position across the roadway and on the rear side of the board a layer of heavy building or roofing paper. This board shall be held in place by stakes until the concrete has been deposited for a distance of at least 6 ft. in advance, when it shall be removed and the place it occupied carefully filled with concrete and finished in same manner as the rest of the pavement. The paper used must be stiff enough to maintain itself without tearing or wrinkling and shall not extend above the surface of the pavement.

Between the curb lines of an intersecting street or alley that is unpaved, the concrete pavement shall be finished against a white-oak plank 2″ thick and 12″ deep and of such length as the engineer may designate; the upper edge of the plank to be neatly adzed off to conform to the finished surface of the pavement. Where the work adjoins any pavement already laid, the engineer may require the contractor to remove and relay a sufficient quantity of the old pavement to form a satisfactory junction of the two pavements.

Sprinkling—During the first four days after placing, the concrete shall be kept moist.

At all times during the construction of the pavement nothing must be allowed upon it that will disturb the concrete while setting, and the street shall not be thrown open to traffic until the engineer so directs.

One Mile of Concrete on Superior Boulevard, Minneapolis

One mile of concrete has been put down on Superior Boulevard, extending out of Minneapolis. (See issue p. 25)

The concrete is 14′ wide and 7″ thick of a 1:2:3 mix, using sand and gravel which was sucked out of Lake Minnetonka, near by and screened.

An excellent grade of material was obtained but there was mixed in with these aggregates taken out of the lake many small pieces of bark and water soaked chips. The laborers were cautioned about removing these and did the best they could but after the roadway was completed, it was found many of these chips of wood had dried out, thus shrinking and leaving pitholes from ¼″ to 2″ deep. The contractors after discovering this, dug out the wood and filled the small holes with cement grout.

This road is in part on a very heavy and deep fill of sand and gravel (about 18′ deep), and each rain is showing the wash-down of the fill so that there is some doubt as to the concrete staying in place

The engineer did some cutting through the hills and filling in and has made an excellent job. The grade on the finished road is good and the curves show excellent engineering work.

Steel plates for protection of the concrete at expansion joints were used.[1]

The contract was let last year but owing to shortage of labor, work was not completed until this year. The work was done by the General Contracting Co., Minneapolis.

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[1] [illegible]

[2] [illegible] Sept., [illegible]

[3] [illegible]

[1] Made by [illegible], Minneapolis.

Concrete Organizations, Officials and Conventions

American Concrete Institute, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa. Convention, Chicago, Feb. 16-20, 1914.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Building, Washington, D. C. Meets as part of American Road Congress, Detroit, Sept. 29-Oct. 4.

American Road Builders' Association, Secretary, E. L. Powers, 150 Nassau St., N. Y. C. Convention and Exhibition, First Regiment Armory, Philadelphia, Dec. 9-12, 1913.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Building, Philadelphia, Pa.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy.-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill. CHICAGO Show, Coliseum, February 12-21, 1914.

Iowa Association of Cement Users, Henry H. Dean, Glenwood, Ia., Secretary.

Nebraska Cement Users' Association, Secy.-Treas., Frank Whipperman, Omaha, Neb. Convention Feb. 2-4 and Show Jan. 30 to Feb. 4, 1914, Omaha.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Bldg., Minneapolis, Minn.

Tentative Program for American Road Congress is Announced

The tentative program for the Third American Road Congress, held under the auspices of the American Highway Association, American Automobile Association and Michigan State Good Roads Association, at Wayne Gardens, Detroit, Sept. 29 to Oct. 4, 1913, is announced as follows:

Monday, September 29

Registration — 9 a. m.—Continuing throughout the Congress registration of members and delegates at Secretary's office, Wayne Gardens, where badges, program cards, etc., may be obtained after registration. Blank forms for registration may be obtained at hotels or at Wayne Gardens. 10 a. m.—Meeting called to order in Wayne Gardens by Logan Waller Page, President of the Congress. Addresses by Woodbridge N. Ferris, governor of Michigan; Oscar B. Marx, mayor of Detroit; Logan Waller Page, president, American Highway Association; Laurens Enos, president American Automobile Association, and others. 2:30 p. m.—The national administration will be represented at the Congress by one or more members of the Cabinet, and President Wilson has promised to write an address to be read at one of the sessions. It is expected that this address will be read at the afternoon session of the first day and that distinguished officials of the Canadian government will also take part in this session, concerning which definite announcements will be made later.

Social Features—Plans are under way looking to the holding of a reception or garden party late in the afternoon of the first day in honor of the distinguished guests of the Congress. This will be followed by a series of banquets and entertainments by the Board of Commerce, the Wolverine Club, the Rotary Club, the Adcraft Club and others.

Tuesday, September 30

National Legislation, under auspices of American Automobile Association—10 a. m.—Opening address by the presiding officer, Frank E. Doremus, M. C. (introduced by George C. Diehl, chairman, Good Roads Board, American Automobile Association). Addresses on proposed National Aid or National Highways by the leading advocates of the respective measures which have become prominent. It is expected that among the speakers will be Jonathan Bourne, Jr., Chairman, Joint Congressional Committee on Federal Aid in the Construction of Post Roads; Claude A. Swanson, United States Senator from Virginia and member of the Joint Committee; Dorsey W. Shackleford, chairman, Good Roads Committee of the United States House of Representatives. Speakers representing the Lincoln Highway Association will occupy a portion of the program at this session. This session will be thrown open to general discussion after the principal addresses and a committee on resolutions will be appointed, which will confer with the advocates of various plans of legislation in an endeavor to prepare resolutions which may be presented to the Congress of the United States as representative of the organized road movement of America.

State Legislation and Road Management Session, under the auspices of the American Bar Association. Committee—Frederick D. Wadhams, Albany, N. Y., Chairman. William D. Sohier, Boston; Henry D. Estabrook, New York. Addresses by William D. Sohier, chairman, Massachusetts State Highway Commission, who will explain the lessons learned at the International Road Congress in London and present his observations of European road systems; an address on the Merit System in Road Management by John A. McIlhenny, president, United States Civil Service Commission; The Evolution of Road Legislation in Ohio, and its relation to Road Legislation in other states, by James R. Marker, State Highway Commissioner of Ohio; Systematizing the Purchase of Road Material and Equipment by Henry G. Shirley, Chief Engineer, State Roads Commission of Maryland.

Social Features — Special entertainments will be given in the evening by the manufacturers represented at the Congress, concerning which definite announcement will be made from the platform and by bulletin.

Wednesday, October 1

Construction and Maintenance Session, under auspices of American Highway Association—10 a. m.—Opening address by the Chairman, J. N. Carlisle, State Superintendent of Highways of New York. Papers will be read by title only and followed by discussion.

Social Features—A boat ride will be given in the evening, to which all delegates and members in attendance at the Congress are invited.

Thursday, October 2

Road Users' Session, under the auspices of American Automobile Association—10 a. m.—Opening address by George C. Diehl, Chairman, Good Roads Board of the American Automobile Association, presiding. Program to be announced.

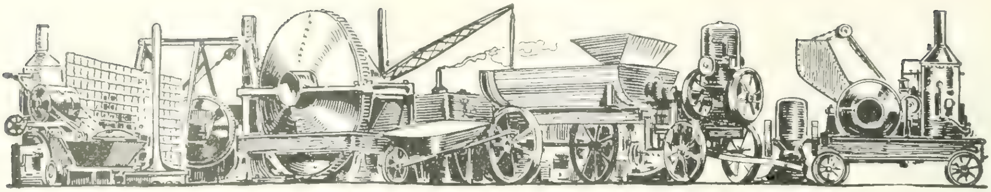
Finance Session, under the auspices of American Bankers' Association — 2:30 p. m. — William G. Edens, of Chicago, Chairman. Papers and addresses will be given dealing with the various phases of road finance and accounting by men who have made a special study of this subject. Among the papers will be one on financing of road improvement by Wm. G. Edens, President, Illinois Highway Improvement Association; Bond Issues for Road Improvement, S. E. Bradt, Vice-President First National Bank, DeKalb, Illinois; Highway Accounting with Special Reference to Maintenance, by H. P. Gillette, Editor *Engineering and Contracting.* (Other addresses to be announced.) Evening—(To be announced.)

Friday, October 3

Michigan Day, under the auspices of Michigan State Good Roads Association—10 a. m.—Meeting opened by Chairman P. T. Colgrove, President of the Michigan State Good Roads Association. Addresses by Governor Ferris, Senator Charles A. Townsend, who will speak on national legislation; Jesse Taylor, president, Ohio Good Roads Federation, on "Road Legislation and How to Get It," F. F. Rogers, State Highway Commissioner, on "Concrete Road Building," William Bryant, Kalamazoo, chairman, Good Roads Association of Kalamazoo County, will speak on "Prison Labor on the Roads of Michigan"; Frank N. Sparks, Editor Grand Rapids Herald, will present a paper on "Roads of Kent County and Western Michigan"; Frank Hamilton will speak on "West Michigan Pike Association." These addresses will be followed by five-minute talks. Evening—Meeting of the American Highway Association at Hotel Pontchartrain, for election of officers, consideration of reports, etc.

Saturday, October 4

10 a. m.—Presiding officer, Dr. Jos. Hyde Pratt, State Geologist of North Carolina. Report by Committee on Resolutions and discussion. Presentation of invitations from cities for 1914 American Road Congress.



New Equipment, Methods and Materials

The forward progress of any industry is measured by the tools with which it works, and the engineer-manufacturers who are developing new and better methods and materials, merit recognition and co-operation. In this department are published brief descriptions of the new developments of the field

The Chicago Street Paver, with Distributing Chute

The new No. 14 Chicago Paver, made by the Chicago Concrete Machinery Co., Milwaukee, is shown in the accompanying illustrations—in detail (Fig. 1) and in action with its 15-ft. cylinder distributer (Figs. 2 and 3). The mixer has a capacity of 20 cu. ft. of loose material or 14 cu. ft. of mixed concrete per batch. The manufacturers say that while the machine was always large enough to hold the present batch, it was not until this season that it had sufficient horse power on it to make it a two-bag machine. It is now equipped with an 8-h. p. engine and a 14-h. p. boiler. The daily capacity of this machine, the manufacturers say, ranges from 1,800 to 2,100 surface yds. of 6-in. base, and the best record attained is that of Mr. Slobohn, Los Angeles, Calif. This contractor put in more than 2,300 surface yds. of 6-in. base in one day with 23 men. This was the day before the Fourth of July and one of the hottest days of the season. This particular test was made in the presence of the city engineer, two or three county engineers and various contractors.

On this machine the power plant and drum are centrally located, so that the parts are well balanced and there is less chance that equipment will get out of alignment, or wear unequally.

The loading skip is 9′ across, and on the No. 14 size is very low; when hoisted it has a very steep discharge angle, so that the materials are discharged freely and with rapidity.

From the drum, fitted with the company's standard discharge blades, the mixed concrete is discharged by means of a short chute directly into the revolving distributor. The end of this distributor, nearest the drum, is equipped with a receiving hopper which takes care of the batch from the drum, chutes it into the cylinder, which, being equipped with blades, finishes the mix and discharges the finished product directly in the street. This distributing cylinder is unique and one which gives the paver its good capacity. In the first place it is simply a hollow cylinder about 18″ in diameter, supported from a rigid channel iron frame which in turn is supported on the frame work of the mixer. Being well pivoted, this distributor, 15′ in length, swings freely and easily. The mixer is equipped with both forward and reverse traction mechanism, the drive being off of both rear wheels. It is also equipped with a compensating device to take up the unequal motion in turning corners or swinging from one side of the street to the other.

The Ceresit Waterproofing Co., Chicago, has been awarded the Grand Prize at the World's Fair held this year at Ghent, Belgium. This waterproofing material is used extensively in practically every country in the world, on buildings of every type.

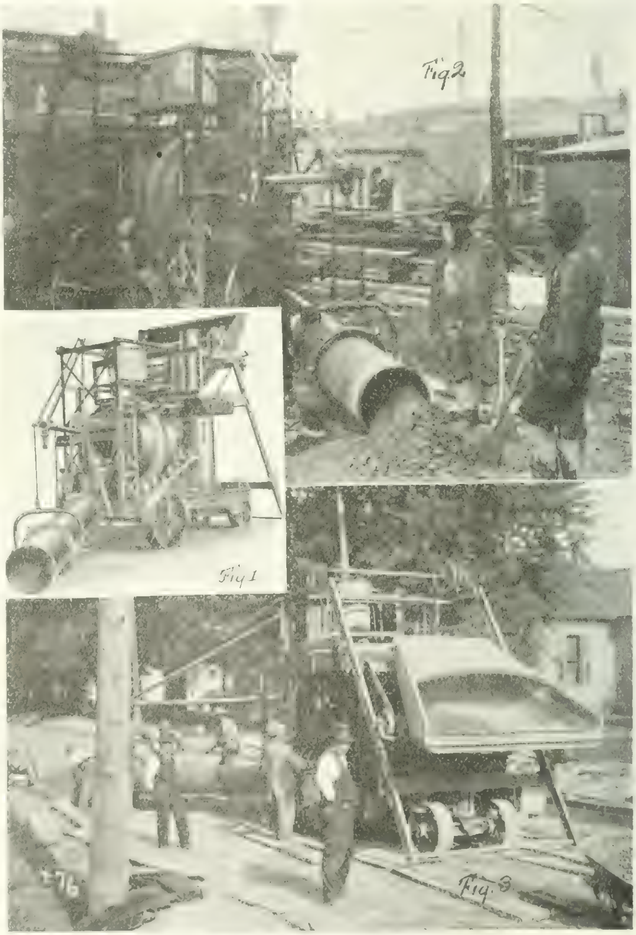


Fig. 1—Chicago Mixer in Detail
Fig. 2—Loading End of Mixer
Fig. 3—Distributing Concrete on Street

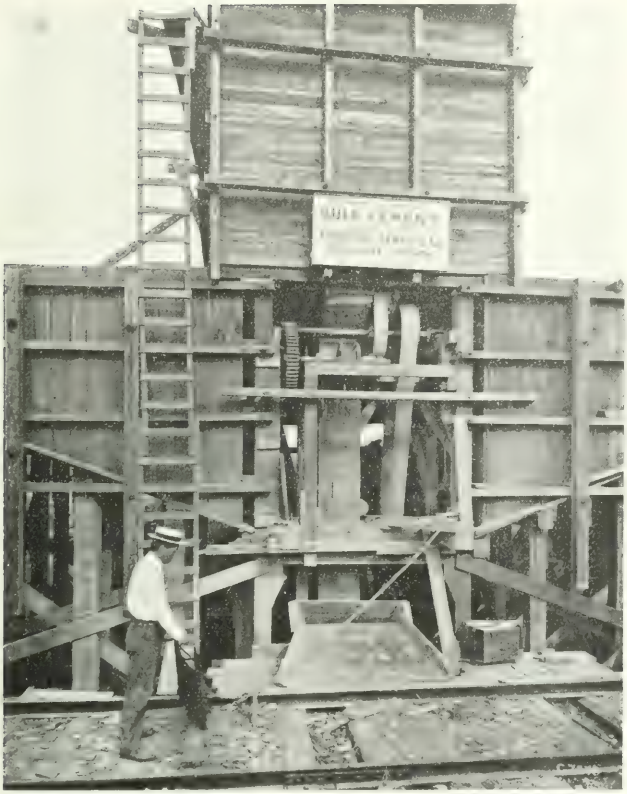


Fig. 1—This Shows the Scraper (at the Left) and the Chute Into Which the Cement is Emptied

Sand and stone bins are at the left and right. The cement bin is above, directly in the center

Unloading Car of Bulk Cement in 1 Hr. With 1 Man

The question of containers for cement, and economical ways of handling them, our sack problem, has been with us for a good many years. It is not so long ago that the important question was "shall we use paper or cloth sacks?" At present, however, the greatest interest is centered in the possibility of transporting cement in box cars in bulk, and the following description, prepared from notes sent in by Gordon Wilson, of the Universal Portland Cement Co., Chicago., and W. L. Chandler, of the Dodge Mfg. Co., Mishawaka Ind., presents in detail new equipment which has been installed by the H. A. Strauss Co., contractors for the construction of the new plant of the Baldwin Locomotive Works, near Gary, Ind. With this equipment a carload of bulk cement may be unloaded by one man in about an hour. The labor of this man is the only labor required in the cement handling at any time.

Fig. 1 shows a general view of the equipment for handling the concrete materials on this job and the track on which these materials are received. The bins with sloping bottoms, on either side of the structure, are for the sand and stone, which are handled into them by means of a crane and clam-shell bucket. Spanning the space between these two bins is the bulk cement bin, and below it is the equipment for unloading and handling the bulk cement. This equipment consists of a power scoop similar to that which has been used for a long time in unloading grain, but specially designed with reference to the nature of the material it has to handle. By means of this scoop the cement is dragged to the car door, from where it falls into a chute (shown lying flat on the ground in the picture). The chute carries the cement down into the boot of a bucket elevator, which carries the cement up into an overhead bin where it is stored.

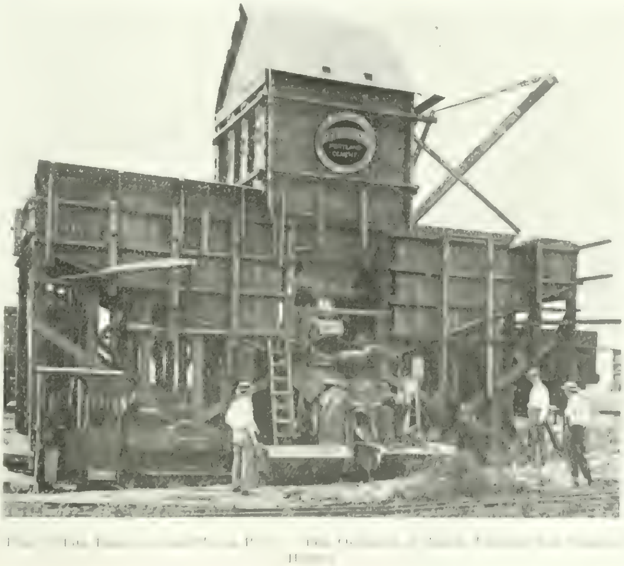


Fig. 2—[illegible]

Fig. 2 shows the mixer side of the equipment. The bottoms of all three bins slope down towards the mixer, and are provided at their lowest points with gates through which the various materials run by gravity, either into the measuring box or into the mixer hopper direct, as may be desired. In the picture the operator is shown in the act of filling the measuring box with cement. It will be noted that the operation of tending and charging the mixer is strictly a one-man job. The mixer discharges into Koppel[1] cars, which are used to transport the concrete to the forms.

An Automatic Drum Expedites Unloading

The operation of the bulk cement equipment is very easy and simple. It will be noted in Fig. 1 that two sheaves are provided by means of which the power scraper can be worked back into either end of the car. The scoop and bucket elevator are both driven by one small engine. The shaft of the machine runs continuously and carries a loose drum and a clutch. On the drum are wound a chain, a counterweight, and the cable which pulls the scraper in the car. One end of the chain is connected to the clutch lever so that when the drum has wound up the chain, it automatically pulls the clutch out of gear. While the drum is in this position, the scraper cable is fully wound on the drum, and the scraper is attached to the cable at the proper point at the car door.

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[1] Orenstein-Arthur Koppel Co., Pittsburg

The operator now takes the scraper into the car any desired distance and gives the cable about a foot of slack. The movement into the car unwound the scraper cable and caused the loose drum to revolve, winding up a counterweight. When the operator permits the cable to slacken, the counterweight immediately pulls the drum around in the opposite direction. One of three steel dogs on the drum at once trips a latch which holds the clutch out of gear, and thus allow a weight to throw the clutch into gear with drum, whereupon the drum revolves and the cable is wound up and the scraper drawn to the car door with considerable cement ahead of it. By the time the scraper reaches the door, the chain is again wound up on the drum and the clutch pulled out. The scraper is then free to be again taken into the car for another load, etc. Therefore, all that the operator has to do in unloading a car is to carry the scoop back as far as he wants to, engage a load of cement and steer it to the car door.

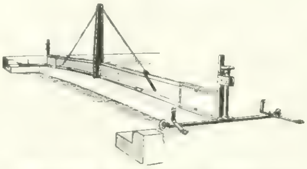
This apparatus has demonstrated more clearly than ever before the economy of bulk cement as compared with the old system of handling the cement in sacks. If the cement on this job were being received in sacks, the sacks would have to be loaded into trucks, wheeled out of the car and into a shed where they would be piled until needed. Then they would be taken off the piles, loaded onto trucks or wheelbarrows again, wheeled to the mixing platform, and there each sack would have to be emptied, lifted up to the mixer hopper and held there until empty, after which all the old, well-known work of protecting, shaking, counting, bundling, and shipping the empty sacks would have to be done. With the equipment that we have described the cement is delivered into the mixer hopper with little more effort or expenditure for labor than is required for the water.

The equipment described is extremely interesting, not only because it is the first of its kind, but also because of the possibilities that it opens up for the most economical handling of materials in the future. This is only a temporary equipment, but it shows what a logical and desirable thing a permanent equipment of this same nature would be in the case of concrete products factories. In this particular case the scoop and elevator handle only the bulk cement. There is no reason, however, why, by slight modification in the arrangement, the same equipment should not handle the sand and stone as well.

* * *

Street Gauge and Joint Wedge

Elsewhere in this issue J. S. McCullough, City Engineer Fond-du-Lac, Wis., writes of the construction of reinforced concrete pavements in Fond-du-Lac. He mentions two items of equipment which at the time that article went to press, we were unable to mention in detail. The guage which is used in shaping not only the subgrade but the concrete surface, is manufactured by P. Roughen, 213 Amory St., Fond-du-Lac. This is shown in the accompanying sketch.



Gauge for Shaping Both Subgrade and Concrete

The wedge which was used in making the joint space between sections of pavements in such a way that the wedge or template will come away readily without breaking the edges of the concrete, was patented by a former Fond-du-Lac contractor who is now dead. The wedges are not being sold but are being used on the royalty basis of 1c per sq. yd. of pavement. Anyone interested in them can obtain information from Mr. McCullough, city engineer, Fond-du-Lac, Wis.

* * *

Waterproofing Companies Combine

The Girvan-Nachod Co., contractors, manufacturers and dealers in waterproofing products, and the Hydrobar Waterproofing Co., contractors, manufacturers and dealers in waterproofing products, have formed a combination under the name of the Consolidated Cos., with a factory located in N. Y. C.

This company is prepared to undertake contracting anywhere in the U. S. for the membrane system of waterproofing with coated or uncoated felts or burlaps; the hydrolithic system of waterproofing for all classes of structures; damp-proof painting by either brush or pneumatic process on the interior or exterior with our bituminous compounds.

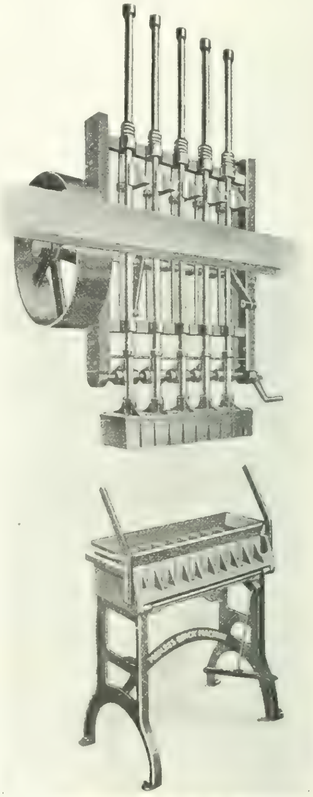
This company has developed a process of window caulking, using McCoy's elastic cement and fireproof packing and both the method and the materials have been approved by the building department in N. Y. C.

* * *

CONCRETE-CEMENT AGE needs copies of the Cement Mill Edition for July, 1913, and will pay 25c each for a limited number. If you have any copies to spare please advise, addressing Detroit office.

New "Peerless" Tamper

The accompanying illustration shows a brick machine equipped with a power tamper put out by the Peerless Brick Machine Co., Minneapolis. The manufacturers mention in favor of this tamper that it has no gears, cogs, chains or eccentrics, that it is compact and takes up no floor space, being suspended above the mold box of the machine. The tamper is made of steel and iron and it is proposed to operate it with 1½ h. p. The tampers are raised by crank arms which are equipped with fiber rollers so that the operation is possible with a minimum of noise. Each tamper drops 18" 85 times a minute and when they are thrown out of operation they stop 18" above the mold box so that there is plenty of room to open and close the machine and to trowel off the product.



Tamper Set Up Over Brick Machine

* * *

The Philippine government has recently announced the plan for a comprehensive system of loans from public funds for public improvements. In all, about $15,000,000 in gold is involved, which will be spent mostly for various municipal improvements. The present schedule calls for 66 reinforced concrete market places. Plans and specifications for these have been prepared and construction will proceed at once.

Concrete-Cement Age

Vol. III OCTOBER, 1913 No. 4

Editorials

THE AMERICAN Road Congress is just opening its third annual sessions. It is evident that the road movement is gathering head. There is a much larger and more nearly representative attendance in Detroit this year than there was at Atlantic City last year; the exhibits of road materials and road making apparatus are more in number, more comprehensive, more instructive. The program is diversified in the extreme. It provides for the discussion of the problems of the actual road builders—the men who have to handle construction and maintenance; for the consideration of the financial end of the road problem, the administrative functions, the legislative situation as regards roads and road departments and the Congress also makes plenty of provision for the discussion of the needs of *road users*. Comparatively few of those attending the Congress will find all the sessions of interest to them; yet each session will shed more light along its own special line, so that men may be expected to go away from the Congress better equipped for the development of roads, no matter in what branch of the work they are engaged. Yet when all the meetings are sifted for the good that is in them, it will be discovered that the Congress has not done its best work in the definite instruction of the road builders in attendance. The work of the Congress will be broader. Its influence will be upon the spirit of road building rather than upon the every-day facts of road building. If the Congress does not tell just *how to do it,* it will at least implant an idea of the necessity of knowing how to do it. And its work will be a mighty one if it spreads over the land a deep realization, among the masses of the people, of the importance of good roads and among the practical men building roads a desire to know how to do it. A lesson is half learned when the idea dawns that the lesson is worth learning.

* * *

IN OTHER pages of this issue we publish a schedule which presents the limits put on the height of buildings by various cities in the U. S. In the past the craze has been for skyscraper buildings, and for this type of construction structural steel has been indispensable. American municipalities are beginning to realize that high buildings are not altogether to be desired and the limit of altitude seems to be, in most cases, well within the height of efficient reinforced concrete construction.

* * *

FOR a good many years Albert Oliver, N. Y. C., has fought aggressively the fight for cinder concrete before various committees revising the Building Code. He has always carried on his shoulder a chip, a dare to all the other building interests to conduct an actual comparative test on concrete, clay tile and other floor construction. As was pointed out in *Concrete Engineering* several years ago, a test was the one thing needed and any building code should be based on test data. In years past in New York, for some reason or other, this test has not been carried out.

In other pages of this issue a report of the test which was carried out this summer is presented. A great deal is due Mr. Oliver for these tests and the following paragraphs from a recent letter of Mr. Oliver's are characteristic of the aggressive, sincere, hard-hitting work of the men fighting for a square deal for concrete in the metropolis:

"I determined, in the absence of reliable data as to the relative merits of concrete and hollow block construction as fireproofing materials, to pay out of my own pocket for the tests that would decide the question. I have believed that interested engineers, architects, owners and the manufacturers of Portland cement and the manufacturers of different classes of reinforcing, should have done this; but undoubtedly the old saw that what is everybody's business is nobody's business, applied in this case, and it seemed to be all along the line taken for granted that George must do it. So George did it, and here are the facts divested of theorizing, guessing, lying and bunk.

"If the bottom face of 10% of the hollow blocks had been declared unsound, it would certainly have furnished sufficient reason to any unprejudiced mind for the rejection for further use as a fireproofing of such defective construction, and when the actual damage is close to 100%, it would seem to eliminate entirely the use of hollow block as a fireproof construction."

Parallelism in Cement and Clay Products

In another column will be found a summary of the report of the U. S. Geological Survey upon the great clay products industry. These products include the several varieties of brick, drain and other tile, sewer pipe, terra cotta, pottery, fire brick and other clay products, the various building bricks representing the greatest value, with a total of $73,425,819 out of a total value of the production of the industry of $172,811,275.

In analyzing the report it is interesting to observe that the 1912 figures show an increase of $10,575,094 over the figures for 1911 or in dollars about a 6% increase. In view of the discussion that has been going on between the clay products industry and the cement industry in some of the trade papers over the attacks made by the former upon the latter, it is an interesting thing to note that the increase in the period named in the clay industry as measured in dollars is practically the same as in the cement industry as measured in barrels, while the cement industry as measured in dollars is considerably below that of the clay industry as above stated. It seems that the clay people have cried before they were hurt.

For purposes of comparison, however, the extremely low prices prevalent in the cement industry in 1912 make it hardly fair to make a comparison in dollars and for this reason the barrel is taken as a unit of comparison as against the dollar in the clay products industry. Upon this assumption it may be said that the antagonistic publicity that has prevailed in the clay industry has done no harm to the alleged competitor, and that in the case of both industries normal gains have been made to relatively the same extent in the year 1912 as compared with 1911. Publicity has attracted attention to both materials and put both of them forward as stronger competitors than ever for wood and other forms of non-fireproof construction.

A Great National Highway

When the Lincoln Highway, which now seems assured as a trans-continental roadways from New York to San Francisco, is completed, it will form not only a monument to the great liberator, but a monument to the recognized advantages of concrete in roadway construction. The route will run through the states of New York, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Iowa, Nebraska, Wyoming, Colorado, Utah, Nevada and California. In detail the highway is planned to pass from New York City through Jersey City, Newark and Trenton to Philadelphia, through the north central section of Ohio, west to Ft. Wayne and South Bend, skirting Chicago and entering Joliet, Rochelle, Sterling and other cities in Illinois. It will enter Iowa at Clinton and leave at Council Bluffs, passing through Omaha and westward to Denver, then north to Cheyenne, west to Green River and Evanston to Salt Lake City, taking in Tippet's ranch in Nevada and including Reno, thence to Lake Tahoe in California and finally resting on the Pacific coast at Oakland and San Francisco.

The highway will be open to lawful traffic of all descriptions without any toll charges, and for this reason, the association back of the enterprise calls upon every loyal citizen and especially officials of each state and county honored by the presence of the highway, to give the project every aid and comfort possible.

Concrete is specified as the construction material wherever possible, for the reason, very largely, that the concrete roads of Wayne county have proven so strikingly successful from every standpoint. They have completely superseded in the public esteem roadways of macadam, which have very generally proven unsatisfactory under modern high-speed automobile traffic.

Detailed accounts of the construction of the Wayne county roads, their installation and up-keep, have been published continuously in CONCRETE-CEMENT AGE for several months past. They tell in detail why concrete has been selected as the chief material out of which the Lincoln Memorial Highway will be constructed.

CONCRETE-CEMENT AGE believes in honor where honor is due. No citizen of the United States deserves a more permanent and universally useful monument than does Abraham Lincoln. No material has a better claim to the honor of aiding in the perpetuation of his services to the nation and to the world at large, than has concrete. We are enthusiastically for the highway and add our voice to the call that is going out for the national co-operation that shall result in this tremendous enterprise being an accomplished fact.

* * *

Elemental Washing Material Method

Elemental means may be crude, but they are almost always simple and this simplicity very often makes for the highest efficiency. In handling any concrete work so much that makes for economy depends on circumstances, that it is almost impossible to judge any method critically without having first considered all the circumstances. Clean gravel and clean sand mean better concrete work. Contractors are slowly and surely realizing this. To a good many contractors, washed gravel appears to be out of the question, for in many localities it is impossible to obtain it, and they are not apparently aware that gravel-washing equipment is within their means. In other pages of this issue is recorded an instance where a simple and, under the circumstances, a very effective method, produces a washed aggregate.

The bottoms of the wheelbarrows that were used to handle the gravel, or crushed stone, as it happened to be in this case, were perforated and on the way to the mixer the wheelbarrow load of material was drenched with a garden hose under a good head, the water and silt draining off through the holes in the bottom of the wheelbarrows. This produced a very good washed aggregate at a very low cost.

It might also be noted in passing that this simple means was, in a way, killing two birds with one stone. It used to be good practice in hand-mixing days always to drench the wheelbarrow load of stone with a couple of pails of water before dumping it on the pile. The method outlined above has the same desirable effect.

* * *

Handling Concrete Work in the Orient

In the current issue we publish an article on the construction of reinforced concrete barracks in the Philippines. The author of this article in a recent letter for the editors, calls attention in an emphatic way to the efficiency of the native Philippine labor, especially for reinforced concrete work. He states that the native labor compares very favorably to the labor in the United States in handling form work and the steel reinforcing materials. In handling concrete the native labor is far cheaper and just as efficient as our American labor. Modern reinforced concrete construction work is very interesting to the Philippine and the Chinese laborers and when it is possible to get the natives interested in their work, the maximum efficiency is obtained and the work done equals that of the white man under similar conditions.

Stairway Efficiency in Fireproof Buildings

In a paper presented before the Am. Soc. of Mech. Engs., H. F. J. Porter, consulting engineer, N. Y. C., presents some very interesting studies of the "carrying powers" of stairways as emergency exits. The paper opens with a statement that a non-fireproof building can be compared to a pile of kindling wood out in the open, sometimes oil-soaked, and always ready to be set on fire. The fireproof building is compared to a stove full of fuel ready to be set on fire. In such cases the human occupants swarm around in the interstices in the pile of fuel, and as soon as the fire starts those caught in the fagots have to work their way down through the smoke and flames to the ground to save their lives.

Some seven or eight years ago, Mr. Porter endeavored to empty a non-fireproof crowded factory building by a fire drill and found to his surprise that a stairway, when the attempt was made to use it by a large number of people entering it simultaneously at different stories, had a very limited capacity. He was unable to empty the building until practically a separate stairway from each story was introduced, and then the stream of people occupying each story flowed into its own stairway at the top and out at the bottom without colliding with any other people on their way down.

In order to insure the safety of the occupants of a building in case of emergency one of two things has to be done: (a) there should be two stairways so that if one is cut off by flames or smoke the other can be used and the number of occupants reduced on each floor to meet the limited capacity of the part of the stairway between floors; or (b) the number of stairways should be increased so as to have two separate and independent stairways from each floor to the ground with its own exit from the building. People can then pour into the top of whichever one is not cut off by the fire and continue down and out at the bottom without colliding with those from any other floor.

It is to a certain extent impossible to secure adequate legislation in the various states, which will produce conditions making for the safety of factory operators and as a solution for this problem, Mr. Porter has suggested, and has well supported his suggestion, that a fire-wall be used in all buildings which house very many people and combustible material. This suggestion means that any such building must be divided into two separate buildings by a fire-wall, with openings at each floor, and with separate stairways. If a fire occurs in any part of the building all the occupants have to do is to walk through the doorway into the other section of the building and the doors close behind them. They can then descend to the ground in safety and in their own time.

Even if an entire section of a building at any height caught on fire, it would be possible with such an arrangement, according to Mr. Porter, to empty it in less than a minute.

In these pages we have already referred to the use of fireproof walls in building construction and contractors and engineers will do well to consider the matter very carefully in the design of fireproof and "deathproof" buildings.

* * *

Are Concrete Form Builders Necessarily Carpenters

When reinforced concrete was a new material it was always a problem to find mechanics trained to handle it. This applied especially to form building and while we naturally turned to the carpenters' trade to supply our form builders, yet it was always more or less evident that carpentry and form building were essentially two different things. One instance in a small town in Michigan is especially recalled where we were putting up probably the first reinforced concrete work that had gone up in that locality and were using carpenters. It seemed absolutely impossible for even an intelligent carpenter to interpret the blueprints of an ordinary engine foundation. They could not seem to realize that they were not building the foundation, but were building temporary forms only, to contain the foundation. They were constantly sawing boards the wrong length and could not get over the habit of years in handling lumber as in house building and similar structures.

It was found to be much better practice to use only a few carpenters and break in handy men as form builders. Along this line a recent bulletin of the General Contractors' Assn., N. Y. C., calls attention to the danger in New York of establishing a prevailing rate of wages, not according to the principles of law laid down by the Appellate Courts, but by resolutions of labor unions and other organizations providing for the payment of certain rates of wages to employees in particular occupations. The different unions of carpenters are complaining that the subway contractors are not paying the prevailing rates of carpenter wages to concrete form builders on the subway work. An investigation is now under way by the N. Y. State Labor Dept. and the unions claim that concrete form workers who work in wood are entitled to be classed as carpenters and to be paid the prevailing rate of wages for carpenters.

The Bradley Contracting Co., which at present is the particular contractor involved, asserts that these concrete form workers are merely handy laborers and are not entitled to be paid more than $2.50 per day, which is a fair prevailing rate for such service. The labor unions seem to think that the rate should not be determined by the prevailing rate for any class of workmen, but should be what they prescribe.

The entire matter seems to reduce to the question asked in the title—"Are Concrete Form Builders Necessarily Carpenters?" Future developments will be watched with interest.

The Spread of Knowledge of Concrete

When H. L. Rogers read his paper on "Cement Mixtures" before the Institution of Engineers of the River Plate, South America, he stated a fact with which we are all familiar, but in such brief language that it is well worthy of repetition. In the opening of his paper he said:—

> With all deference to experienced engineers who may have dealt with concrete before me, I wish to say that, in my opinion, concrete is a building material which is the least understood of all constructional materials. It is the custom to say that the present age is a cement age, and in addressing those who will perhaps maintain that it is yet a steel age, I should explain such a statement in this way:
>
> That the tendency in modern constructional work differs from that prevailing less than a generation ago; we have not only assimilated the manifold virtues of steel, but we have advanced a further step. We now combine scientifically *all* the valuable properties of steel and iron with those of a material quite as valuable in its way, and we thus produce a combination possessing the virtues of both its ingredients, perhaps enhancing them, and at the same time we have eliminated some of the serious objections to the use of naked steel—e. g., its corrodibility, great conductivity as regards heats, etc.
>
> A modern engineer is well informed as to the properties of mild or cast steel; he is less informed, as a rule, about the various kinds of cement—the true artificial or Portland, the natural, slag, Roman, and so on, and least of all about the nature of the various mixtures of these materials with inert materials.

This is so true and yet such a natural result of the earlier developments of the iron and steel industry as contrasted with the Portland cement industry, and it is by the recognition of this fact and the presentation of papers such as Mr. Rogers has read and by the great distribution of literature such as is being done by the Assoc. of Am. Portland Cement Manufacturers, the Am. Sos. of Civ. Engrs. and Am. Soc. for Test. Mat. and the engineering press—that the qualities and characteristics of Portland cement and concrete are becoming more familiar to engineers, architects and the public at large. The great and remarkable development in the use of concrete within the last ten years is almost an industrial revolution and it should be a source of gratification to everyone that this great progress has awakened general interest and is producing a corps of skilled minds devoted to the study of this important and rapidly growing branch of engineering.

Quantity Surveying for Construction Former *Cement Age* readers will remember quite a little work done by *Cement Age*[1] in the opening months of 1912, towards developing discussion relative to the merit of a quantity surveying system of some kind. Quantity surveying, which is in current practice in England and on the continent, consists essentially in having the architect submit to the contractor an accurate and detailed list of the quantities required in the building. All the contractor then has to do is to price the quantities and total up his bid. This work of preparing the quantities is done by professional men who are known as "quantity surveyors"; they are employed by the architect and prepare the quantity survey usually for a fixed percentage of the total work. A letter has recently been received from Duncan M. Robertson, Sec. of the Architects' Bureau of Technical Service, N. Y. C., stating that a movement has been started to establish in this country the system of quantity surveying. The letter illustrates the inefficiency of the present system in the following paragraphs:

For each of the jobs costing $100,000 or more that are estimated in this country, there is an average of 10 bidders. Following the law of averages, each bidder secures one of each of the 10 jobs on which he submits estimates. The cost of preparing those estimates is charged to "overhead" and is distributed pro rata over all of the work actually secured. Therefore, the cost of estimating the nine jobs lost is charged against the one job secured. No matter what obscure system of bookkeeping is followed, in the last analysis, the fact remains that the owner of the tenth job pays the cost of estimating the other nine, in which he has not the slightest interest. It is not necessary to point out the waste of energy and money resulting from such a system.

The architect or engineer issues to these 10 contractors the drawings and specifications for the job on which tenders are asked. Each of the 10 contractors turns the drawings and specifications into his estimating department and the work of quantity taking is carried on, generally, under high pressure—since the time allowed for estimating is invariably much too short—and, with more or less difficulty according to size and complexity of the job, and according to the degree of completeness and clearness of the drawings and specifications. The estimate summary sheet of quantities is finally prepared and turned over to the men who price up. All 10 bids are handed in and the contract very often is awarded to the "wildcat" contractor who has been unfortunate enough to have made an error in his computation of quantities. This unfortunate contractor is not in business for love or glory; so he immediately starts to see how he can make good his loss. He sizes the job up for extras. He takes advantage of every technicality in the specification and drawings. He "shops" around for his sub-contractors, if he is a general contractor, until he hooks a "sub" who, unfortunate like himself, has also made an error in quantities. The result under such circumstances is inevitable—the work suffers. It is an axiom that the owner never gets more than he pays for. Estimating under conditions—which are more or less general today—is nothing more or less than gambling on the precision with which quantities are taken. As an after consideration, and as a matter of necessity the contractor is forced to resort to methods efficient and economical, if not ethically dishonest.

The letter further states that the Am. Institute of Quantity Surveyors has been formed which proposes to establish, in place of the present inefficient and wasteful methods, a system of estimating on bills of quantities; that is, the architect and engineer will issue with his drawings and specifications a survey or bill of the quantities of the various classes and kinds of work and materials entering into the proposed construction. And the contractor will set his prices against the various items in the survey. His estimate will then be a statement of the fixed amounts of money for which he will furnish the fixed quantities of materials in accordance with the requirements of the plans and specifications. Under such a system, estimating will become a competition between contractors in efficient methods and sheer ability. Efficiency will be rewarded. The careless, dishonest and inefficient contractor will be obliged to change his policy and methods or die of starvation. He will leave no mourners. If the ultimate quantities of materials actually entering into the construction vary from the quantities set forth in the bill or survey, constituting the basis of the contract, the money amount of the contract will also vary accordingly. There will be no disputes over extras and deductions resulting from changes.

The owner must assume full responsibility for the bill of quantities published with the drawings and specifications. Otherwise the ends sought will be completely defeated.

The letter goes on to say that the quantity system of estimating will very naturally appeal most strongly at first to the contractor. The architect and engineer will find it necessary eventually to organize his office to prepare accurate bills of quantities; the owner to pay the cost. He does so now, indirectly, and it ought not to be difficult for the architect or engineer to convince him that he will pay no more but in fact considerably less since he pays for the estimating of his own job only and not for the nine other jobs as well which his contractor failed to "land." The adoption of such a system will, indirectly, have another beneficial effect; it will impose upon the architect—and the implied criticism is probably more fully justified in the case of the architect than in the case of the engineer—the necessity of following more precise and fairer methods in the matter of making estimates for payments; since all payments will be computed on the basis of units of materials times the unit price.

To establish such a system as that proposed, it is first essential that there shall be a standard unit for the measurement of each and every class of materials entering into modern construction. It is for the purpose of taking this intermediate step that the Am. Institute of Quantity Surveyors has been organized.

Quantity Surveying General in Europe

There is nothing new or revolutionary about the system of estimating on bills of quantities. It has been firmly established in the countries of the old world for years, as the result of discarding the very same improper and extravagant methods now in vogue in this country. In 1909, at a conference among the Nat'l. Fed. of Bldg. Trades Employers, the Inst. of Builders and the London Master Builders Assn., all of Great Britain, a resolution was adopted recommending that the members of these powerful organizations decline to bid in competition with one another unless bills of quantities were supplied for their use at the owner's expense. It would be well if some such concerted action were taken by the many contractors' organizations in this country, but that will come in due course.

The work of formulating the rules for measurements will be done by the Association through committees in each trade. The reports of these committees on standard rules for measurements, as they are adopted, will be established as standards throughout the country.

At the present time this campaign for better methods is being carried forward enthusiastically. A monthly bulletin, *The Quantity Surveyor*, is now published in San Francisco, under the auspices of the Institute, directed by G. Alexander Wright.

Until the movement acquires momentum, the small expenses will be defrayed by voluntary contributions from its originators; so, for the present, there will be no membership dues or other assessments.

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[1] The previous discussion in *Cement Age* of the quantity surveying system consisted principally of editorial comment and the publica- [illegible] Department of several letters from architects and builders expressing their opinion as to the feasibility of the proposed system. In publishing the report of the Committee on Measuring Concrete of the N. A. C. U., the possibility of quantity surveying system was pointed out. The following, in detail, are the references above referred to:

		Page
Jan. 1912	"The Quantity Surveyor"..... [illegible]	7
	[illegible] Chas. S. Keefe, W. P. An- [illegible]	16
[illegible]	[illegible]	[illegible]
" "	"The Quantity Surveyor"..... [illegible]	[illegible]
Apr. "	"Estimating Standards and the Quantity Surveyor"........	
	[illegible] Concrete of the National [illegible]	[illegible]

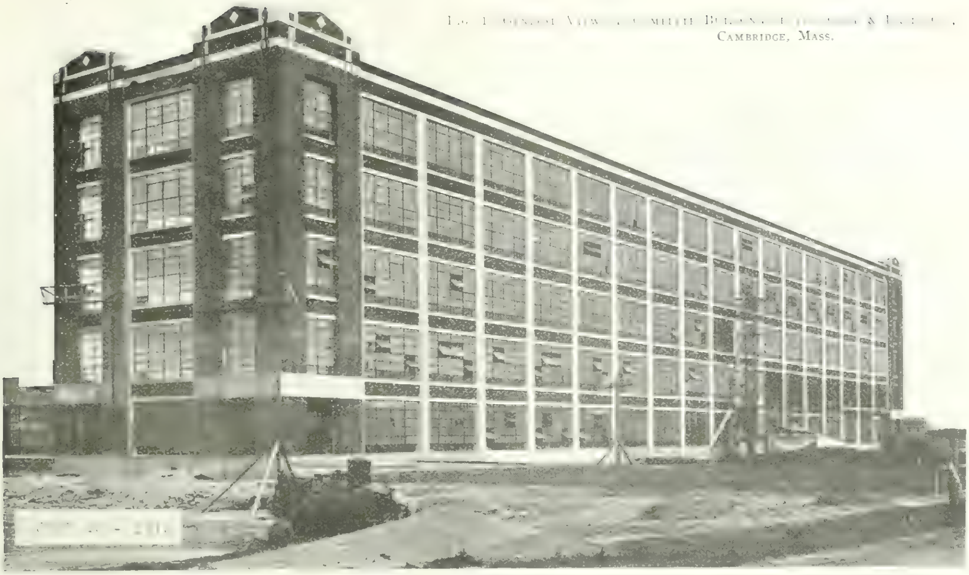

Fig. 1—General View of Completed Building of Gray & Davis, Inc., Cambridge, Mass.

The Construction of a Model Factory Building*

Concrete and Glass Walls Give "Day-Lighted" Factories — Fire, Disease and Decay Proof

On the banks of the Charles River Parkway, Cambridge, Mass., a model reinforced concrete building has been erected by the Aberthaw Const. Co., Boston, for Gray & Davis, Inc., manufacturers of automobile electric lighting and starting systems. The new building occupies a commanding situation overlooking the Charles River and can be seen for many miles around, for the ground is clear on all sides. The importance of the situation made it necessary that the building should be architecturally excellent, with the result that the structure looks more like the best class of office building than a factory. This artistic result has been obtained by a well chosen design, a careful finish of the exterior exposed concrete and the use of tapestry[1] brick at the ends and above and under windows.

Design of Building

The over-all dimensions of this building are 381′ 6″ long by 61′ wide. The building rests on concrete footings, the interior ones being 7′ by 6′ and going 20′ below the first floor level. The entire structural frame is of reinforced concrete.

Extending the length of the building on every floor are two rows of columns spaced longitudinally and transversely 20′ o.c. The floor construction is of the flat slab or girderless type, the columns being 24″ in diameter on the first floor, and 22″ on the second floor, 20″ on the third, while on the fourth and the fifth they are 16″. Steel sash is used throughout and the window area is over 70% of the wall area. It is a veritable daylight factory.

A large show room occupies the first floor, while the offices are on the second floor, occupying the full width of the building for a length of 200′. The directors' room and the private office of Mr. Gray are lined with a special design of tapestry brick containing large fireplaces, and fitted with every convenience.

In the construction of this building the Aberthaw Const. Co. has apparently made a speed record. From the time the concrete foundations were begun only 57 days elapsed until the roof was completed. Before the building was started the ground was covered with about 18″ of water and it was necessary to do some filling in before the contractors' plants could be put in place.

Construction Plant

In Fig. 3 is shown the general arrangement of the construction plant used by the contractors. The aggregates, which consisted of crushed gravel and Newburyport sand, were conveyed by wagons to piles located adjacent to the covered loading platform of mixer. The materials were then taken by wheelbarrows up on the loading platform and dumped into the hopper of mixer, the hopper being level with the top of the loading platform floor. After being mixed, the concrete was hoisted by electric hoist to the floor desired and distributed by V-shaped cars[2] running on tracks to the various forms. The steel tower was located at the front and at the center of the building. The cement was received on railroad cars on the Boston & Albany R. R. switch located at the back of the building and was conveyed by industrial cars to two piles which were kept inside of the building on the first floor. As required, the cement was loaded on the industrial cars and conveyed to the loading platform.

The planed lumber was received and piled systematically before the sawmill in which were located a swing saw, a saw table and an emery wheel, all of which were motor-driven. At the back of the sawmill were the "making-up" benches. As the forms were finished they were stored to the right of the benches and then raised to the various floors by two

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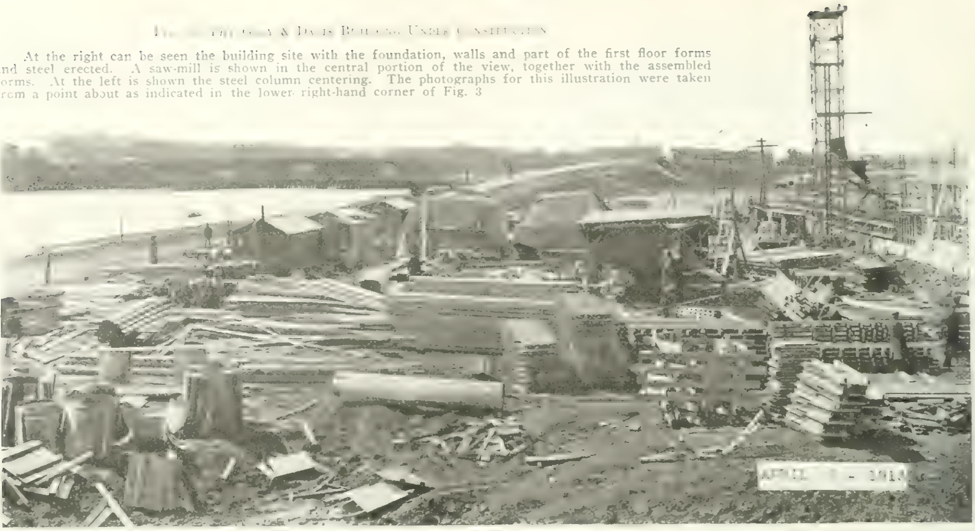
[1] [illegible]

*[illegible] Mar. [illegible]

[2] [illegible] crete Machy. Co., Dunellen, N. J., and the [illegible]

[illegible] & Davis Building Under Construction

At the right can be seen the building site with the foundation, walls and part of the first floor forms and steel erected. A saw-mill is shown in the central portion of the view, together with the assembled forms. At the left is shown the steel column centering. The photographs for this illustration were taken from a point about as indicated in the lower right-hand corner of Fig. 3



movable derricks operated by an electric hoist. These derricks have been designed by the Abertham Const. Co., and are standard equipment on their work. This derrick is simply a 30-ft. or 35-ft. gin pale fastened to the outside of the building, or to work already constructed. In this position it raises forms, steel and miscellaneous material to the floor under erection. The pole is operated by an electric hoist.[3]

The reinforcing steel consisted of stirrups and flat bands 1" by ⅛", and no trussed rods were used. Stirrups were bent by a stirrup bender and there was also a shear on the job.[4] The steel was hoisted to the various floors by the two movable derricks already mentioned.

The floor forms were made of corrugated sheet iron[5] and these were piled in back of the building and nearby was a re-corrugating bench.

The placing of the derricks on the other side of the building from the mixer avoided considerable congestion.

Forms

In the construction of this building the floor forms were of steel as mentioned, while the columns were molded with Des Lauriers steel forms.[6] These forms may be made any diameter by inserting additional sections, after which they are bolted together and held in place by steel clamps. A detail of the centering for the floor is shown in Fig. 5.

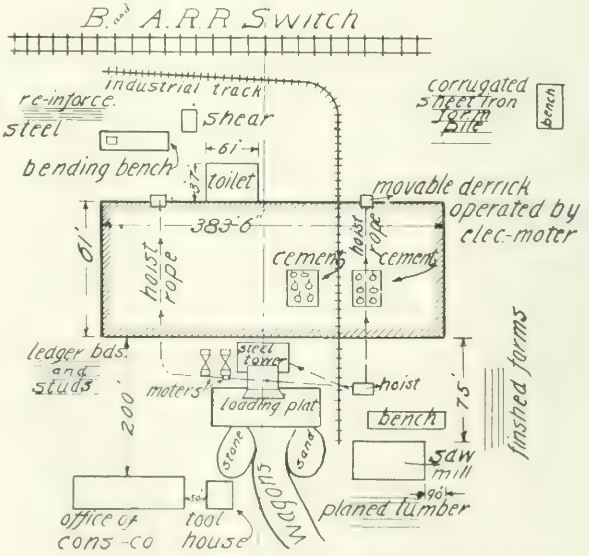
Construction Details

It should be noted that on every floor there was a mezzanine floor with toilets and vaults, the wall construction being of hollow terra cotta blocks. These vaults will be used for the storage of fine tools. At the center of the building is a freight elevator, while at one end, near the offices, is a passenger elevator. The building is equipped throughout with automatic sprinklers, the sprinkler heads being spaced on squares 10'x11'. The main supply line runs down the center of the building and between every two bays two sprinkler lines run off at right angles. The inserts for this building are spaced about 4 ft. on centers, while all the electric wires run in conduits placed in the concrete at the time of pouring.

The concrete generally used was a 1:2:4 mix, using crushed stone. A richer mix was used for the columns, a 1:2½:3 mix for exterior and a 1:1:2 mix for interior columns.

Finish of Building

The interior columns for the main part of the factory are finished by rubbing down with a wooden float and filling all holes with cement and sand. After this they are painted with cold water paint to which bluing has been added to make it brighter. The paint is put on with a spray.



[illegible] Plan [illegible] the Layout of the Building and Plant

Note in this layout that the contractors are working all around the building. At one side of the building, shown at the bottom, the concrete materials are handled and the form work is assembled. In the upper right corner are shown the yard for the corrugated sheet iron forms and the re-corrugating bench. In the upper left hand corner is shown the steel assembling yard

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was furnished by The Maine Elect. Co., Portland, Me., and the Mead-Morrison Mfg. Co.,

[4] The flat stirrup bender was made by the Wallace Supply Co., Chicago. The Wiener Machy. Co., N. Y. C., furnished the shear

[5] Penn. Metal Co., Boston

[6] Des Lauriers Column Mold Co., St. Paul

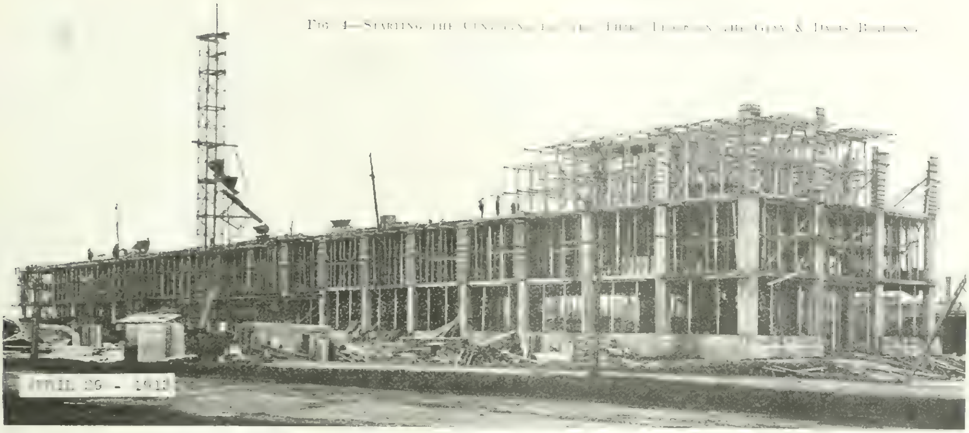

Fig. 4—Starting the Construction of the Third Floor on the Gray & Davis Building.

The exterior walls and the columns in the offices are finished by rubbing down first with a float and filling all were dry they were rubbed down *twice* holes with cement and sand. After they with wet carborundum. This has given the exterior concrete an excellent finish, the coloring being even.

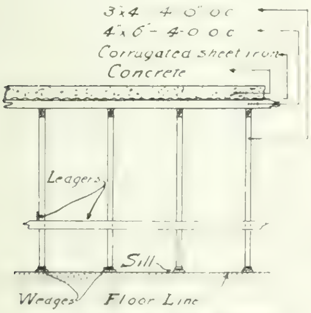

Fig. 5—Detail of Floor Construction, Gray & Davis Building

Damp-Proof Walls

In a recent issue of *Progress*, an enterprising New Zealand contemporary, are published some observations on damp-proof walls in which it is stated that unless the composition of a wall is impervious to moisture, there is no advantage in a thick wall as against a thin one, for if the moisture will pass through one inch, it will pass through the remaining thickness. Therefore a thin wall with a coating of thin impervious plaster will exclude damp, where a thick wall with no coating will let it pass through. With a very thick wall, however, a moderate rain storm may not continue long enough to wet it quite through, but in the case of water tanks and similar objects, thick pervious walls are no better than thin ones, except in the matter of strength. Hollow walls are sometimes adopted for dwellings, the air spaces in the walls preventing the moisture from passing through to the inside. This is regarded as a cumbrous expedient, and after due consideration, reasonably thin and porous concrete walls with an impervious coating have been successfully adopted, making walls and partitions one standard thickness, and thus gaining space in the rooms, and time in erection, which means less cost and a better job altogether.

Fig. 6—[illegible]

Sessions of Third American Road Congress in Detroit

The Third American Road Congress, with a program opening September 29 and ending October 4, is just getting under headway in Detroit as this issue goes to press.

The first day's program included speeches by Logan Waller Page, President of the American Highway Association; Secretary Houston, of the Department of Agriculture; A. W. Campbell, deputy minister of Railways and Canals, of Canada; Col. William D. Sohier, chairman of the Massachusetts State Highway Commission, and Frank W. Buffum, state highway commissioner of Missouri. In the evening there was a spirited get-together banquet at the Pontchartrain hotel.

Tuesday's sessions, under the auspices of the American Automobile Association and American Bar Association, are to bear chiefly upon national and state legislation.

Construction and Maintenance

Wednesday's session, by far the most important from the viewpoint of practical measures, is under the auspices of the American Highway Association, and includes in its program papers as follows:

"Unsurfaced Roads," W. S. Keller, State Highway Engineer of Alabama; Discussion to be opened by George W. Cooley, State Highway Engineer of Minnesota; "Gravel Roads, Their Construction, Maintenance, Cost and Special Treatment," S. Percy Hooker, State Superintendent of Highways of New Hampshire; Discussion opened by Leonard Tufts, Pinehurst, N. C., "Treatment of Worn Out and Ravelled Macadam Surfaces," Col. E. A. Stevens, State Highway Commissioner of New Jersey; Discussion to be opened by Robert C. Terrell, State Commissioner of Public Roads of Kentucky; "Bituminous Macadam, Construction and Maintenance," S. D. Foster, Chief Engineer State Highway Department of Pennsylvania; Discussion to be opened by W. A. McLean, Provincial Engineer of Ontario, Canada; "Drainage Structures," A. R. Hirst, State Highway Engineer of Wisconsin; Discussion to be opened by Prof. T. H. MacDonald, State Highway Engineer of Iowa; "Brick Roads," James M. McCleary, County Engineer of Cuyahoga County, Cleveland, O.; Discussion to be opened by R. Keith Compton, Chairman Paving Commission, Baltimore, Md.; "Selection of Road Materials," L. W. Page.

Contract Session

A contract session is to be in charge of J. R. Wemlinger, Sec'y. Am. Soc. Eng.-Contractors, a finance session under the auspices of American Bankers' Association, Chairman, William G. Edens, President Illinois Highway Improvement Association, and an economics session, Chairman, Dr. Jos. Hyde Pratt, State Geologist of North Carolina.

Thursday's program is calculated to interest the users of roads and to increase public sentiment in Good Roads and Friday's meetings are to be under the direction of the Michigan State Good Roads Association, Philip T. Colgrove, President. A paper by Frank F. Rogers, Michigan State Highway Commissioner, on "Concrete Roads," is published in this issue.

Concrete Roads*

FRANK F. ROGERS†

Much of value has been written in the past two years on concrete roads and pavements, but a great deal is in the nature of theoretical discussions quite largely based on laboratory experiments, hence when an opportunity is offered to make a field study of many miles of concrete roads, some of which have seen four years of service, it should not be lost.

The writer makes no claim to being a concrete expert but simply has been fortunate in having the opportunity to study at first hand, and in some detail, the behavior of a large mileage of concrete roadways in Wayne county, Mich. This county, without doubt, has a larger mileage of concrete roadways than any other county in the United States, or than is possessed by any equivalent area under a single local government in any foreign country. There are now completed in Wayne county about 65 miles of concrete highways outside the corporate limits of cities and villages.

For the reasons above stated, the writer desired to spend the time allotted to him in a somewhat detailed study of the local concrete roads which most of you will visit before leaving the city rather than to treat the subject in a more general way. All of the main highways leading out of this city have been concreted to the outermost boundaries of Wayne county and several cross-roads have already been concreted. The principal roads are the extensions of Woodward, Grand River, Gratiot and Michigan avenues, while River Road and the extension of Fort street running southerly are concrete roadways that should not be overlooked.

The State Highway Dept., with the co-operation of the road officials of Wayne county and assisted by Prof. John J. Cox, instructor in highway engineering at the University of Michigan, has just taken up some detailed and rather minute observations of these roads which will extend over a period of years in the hope that after a while a safe estimate can be made of the probable life and cost of maintenance of such pavements as the county is now building, and under such traffic, soil and climatic conditions as prevail in this locality.

The first work in this study will be careful traffic records covering such time and at such frequent intervals as will give a reliable estimate of the average daily traffic for one year. The first records were taken for one continuous week beginning Aug. 21 and a part of this record which is given in the accompanying table will be used for the purpose of the present discussion.

The next step was to start a permanent record showing the present condition of each 25-ft. section (the distance between expansion joints) of all the different roads. The observations for this record were made Sept. 2, 3 and 4, and cover 6,384 sections and a little over 30 miles of road. Several pieces of road have not been taken at this time. The oldest roads were built in 1909 and the newest that were taken were built in 1912, having been down one year.

For the purpose of this record the defects in the slabs or sections have been classified as longitudinal, transverse and diagonal cracks and holes. The records were taken in ordinary field books, the left hand column of the left hand page having been previously numbered with an automatic numbering stamp to designate the record number of each slab, while the four columns to the right were headed L—T—D—H, respectively, being the first letters of the words indicating the defects named. Opposite each number and in the proper columns vertical, horizontal or diagonal marks were used for symbols to indicate the form of the crack, while small ovals were used to indicate such holes as seemed worthy of note. Tar had been spilled on many spots that were not defective.

Woodward Avenue Road

The first mile of this road was built in May and June, and opened to traffic in July of 1909, thus giving it full four years of wear. The traffic record of this road shows a daily average of 2,160 vehicles, of which 88.1% were motor driven.

The soil is clay loam, inclining a little more to sand at the northerly end. A double track electric railway occupies the westerly side of the street. Between the railway and the concrete roadway is a very shallow gutter under which was laid a tile drain from 2 ft. to 3 ft. in depth. On the opposite side is an open ditch, the bottom of which is from 2 ft. to 4 ft. below the crown of the roadway.

The pavement is 18′ wide, has a crown of 3″ and a blind curb 8″ wide and 4″ deep under the outer edges which were somewhat beveled. The concrete was composed of Portland cement, crushed field stone or cobbles and sand mixed in the proportion of 1:2½:5 for the base which was 4″ thick. The top layer was made of the same materials, using a 1:2:3 mix and was 2½″ thick.

No very definite data can be secured to determine the wear, which seems to be slightly greater on the side opposite the railway, but measuring from some of the harder pieces of the coarse aggregate which have been worn but little, if any, we have estimated the general wear at about ¼″, which would be an average of 1/16″ per year.

This mile was divided into sections of

(Continued on page 189)

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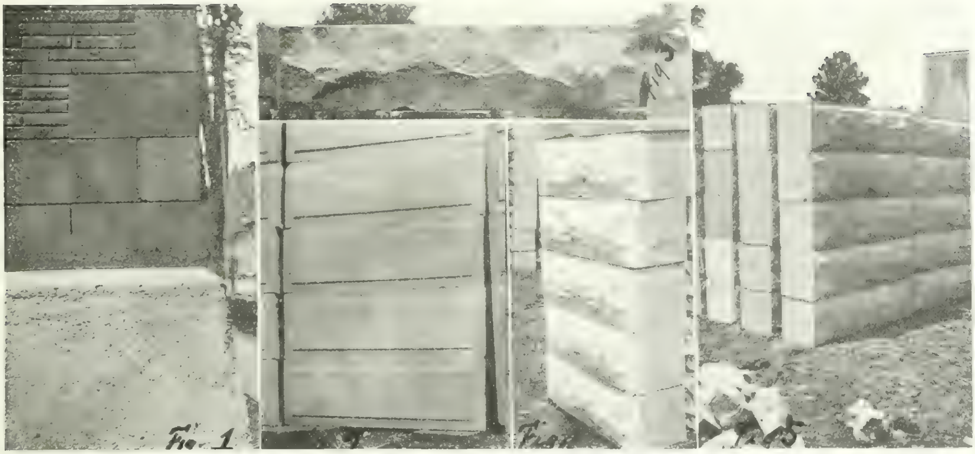
*Read at American Road Congress held at Detroit, Mich., Sept. 29-Oct. 4, 1913

†State Highway Commissioner of Michigan.



Some Concrete Block Faces Which are Obviously Artificial and Some Frank and Honest

Fig 1—A Plain face block of bird's-eye gravel, sprayed; Fig. 2—A so-called bush-hammered block; Fig. 3—A concrete block with a pitched face—done with a mallet and chisel; Figs. 4 and 5—Rock-face concrete block of the common variety

Concrete Products—Architectural Considerations

The Materials for and Treatments of Surfaces of Concrete Building Stone

STAFF ARTICLE

An increasing number of concrete products manufacturers are finding it to their advantage to go to some trouble to learn what kind of concrete products architects want and to make that kind the very best they can.

There are many concrete block manufacturers who are satisfied to turn out a product for use in basement walls and in other places where the niceties of architecture cut very little figure and where the only requirement of the block is that it shall be fairly strong and dense, and many of these manufacturers find a satisfactory profit in this class of work.

There is a field of operation, however, in the manufacture of concrete products which is well under way—a field of operation which involves careful consideration of those things which an architect has to consider in dwellings and other buildings, which, aside from being practical and substantial, must have some claim to beauty.

Concrete products manufacturers who are planning to make a big thing of their business are making up their minds to turn out the product which will please the architect, not that the architect is to be pleased above all others because he is an architect, but because the architect may be said usually to reflect the better taste of the general public in the matter of building forms and materials. At the very outset the architect considers besides structural value, color and texture values, and almost immediately we come to a consideration of the rock-face concrete block. Architects are almost unanimous in declaring that the rock-face concrete block is an abominable building unit, and reason enough for this opinion may be found in Figs. 4 and 5. In Fig. 4 are five rock-face block. The picture was taken in the yard of a large concrete products plant. It is fairly representative of practically all the piles of rock-face block in that yard. About 75% of the product of the plant, where these block were made, is of this type. Glance at the block in the pile—each one of them was molded on the same face place. Then look at Fig. 5—the rock-faces of the 10 block shown are all alike—these and thousands like them made at another large plant. The surfaces have no character and a wall built of such block is not only monotonous and disagreeable in the diagonal lines which the identical faces create, but such a wall is a poor imitation, which fails in the fundamental idea which underlies rock-face stone or block. We have often called attention to the fact that this fundamental idea of pitched stone, that is, natural stone, is *variety*, because no two surfaces are alike.

Fig. 6—[illegible]

Rock-Face Block in Demand

Yet the problem faced by concrete products manufacturers is not one of mere theory. Manufacturers cannot say at once that they will not make rock-face block, although all of them interviewed by the writer recently, agreed that the rock-face block is almost always a hideous and unsatisfactory make-believe. Almost all of them are anxious to do something else, yet the early error of the industry in producing the rock-face block in preference to concrete units of character and beauty has resulted in the creation of a demand for the material which cannot at once be stopped. Products manufacturers [illegible]

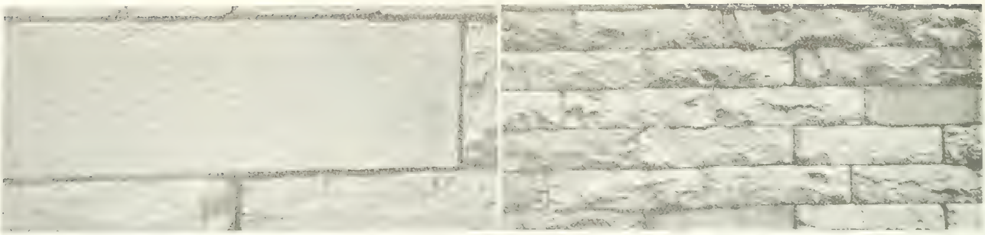


Fig. [illegible]

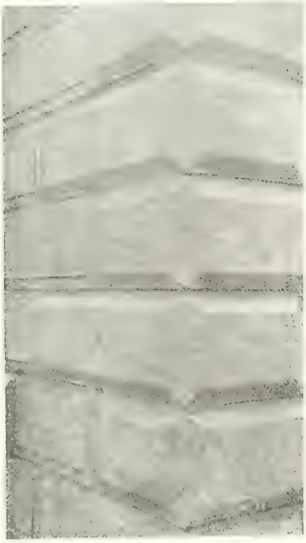


Fig. [illegible]

make rock-face block because they continue to sell them, and they sell them in large quantities, not through architects, but direct to contractors who use them in building foundations and in porch work, etc. This is because that part of the public which buys these block has an idea that the rock-face product is the ideal and the best unit obtainable of concrete. There is, however, a good way in which to combat this tendency of the public to buy the rock-face material—*show the public something else first.* This has been done very successfully by P. E. McAllister, manager of the concrete products department of the Anna Dean Farm, Barberton, O., and it is also being done very successfully by the Paragon Plaster Co., Syracuse, N. Y., where Mr. Boggs, the manager, says he is obliged to make some rock-face block because there is a demand for them, but he keeps these out of sight as much as possible, so that business is gradually getting away from the rock-face block into other types which will be of more lasting credit to his business. Mr. McAllister does not make any rock-face block at all unless they are ordered. The piles in the yard are of other types and the prospective customer is not shown a rock-face block unless he asks for it, and even when he does ask [illegible] an effort is made to [illegible] him from using it.

It may cost concrete products manufacturers a little something to follow this practice, but in the long run, they are sure to be gainers because [illegible] soon the unfitness and the lack of beauty of a rock-face concrete block wall is going to be very generally recognized and the manufacturer who has made the foundation of his busines upon other units and has perfected his methods in turning out other units is

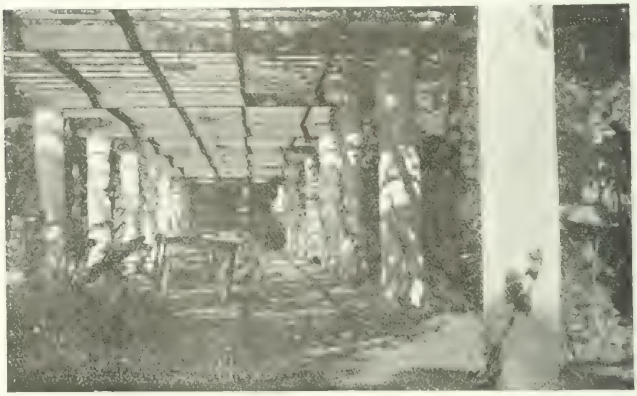
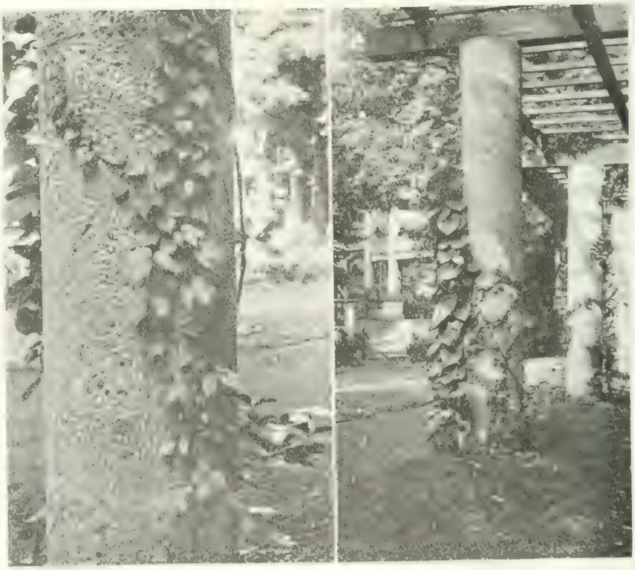


Fig. 10—General View of Pergola With Concrete Columns at Cincinnati Zoo



Figs. 11 and 12—Detail Views of Pergola Columns, Showing Pebble Surface After Use of [illegible] sure to find his products most in demand.

A Real Rock Face Block

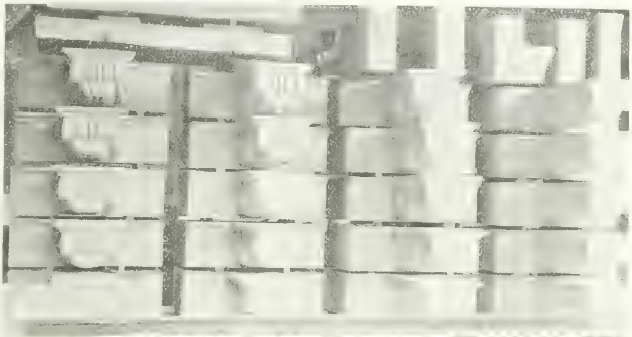
Fig. 3 shows a striking contrast with the products shown in Figs. 4 and 5. Fig. 3 shows a rock-face concrete block. The photograph was taken at the plant of the Central Concrete Construction Co., Louisville. We wish we could show a plate of a whole pile of such block as this one is, but this one shown in Fig. 3 is an experiment. The block was originally cast perfectly plain and square, using a fine stone aggregate, and when it had become hard, it was given its pitched face by a stone cutter, just as a piece of natural stone would be handled. The thing to be observed in this comparison is the difference in quality in the surface. The block which was made perfectly plain and pitched as natural stone is, has real texture values —values which do not exist in the block in Figs. 4 and 5.

Fig. 6 shows a baluster cast as a perfectly square block and turned out in a lathe as a piece of natural stone would be turned for the same purpose. This was also an experiment conducted by the Louisville company and of course there was a good deal of waste material, so that when the stone-cutter had finished with the job, the concrete baluster cost as much as one of natural stone. This, however, was in Louisville, which is in a good natural stone country. Figs. 7 and 8 show more experimental work which was done in Bridgeport, Conn., several years ago. In Fig. 7 are shown large concrete block cast perfectly plain. In Fig. 8 are concrete brick also cast perfectly plain. One of the plain brick as originally cast and a part of another one are shown in the illustration. The other brick have been given pitched faces by the use of a chisel and a few blows with a mallet. Both block and brick shown in Figs. 7 and 8 were made using a facing aggregate of feldspar and were poured wet. This facing mixture was made deep so that the chipping of the surface did not reveal the coarse backing. Although we lack further detailed information on the products shown in these two plates, the plain block in the center of Fig. 7 appears to have been slightly tooled, although having no pitched face. Anyway, the result is a frank, straight forward piece of concrete. It is plain and substantial looking and has an pleasing texture.

To go back to Fig. 1—this plate was taken in Syracuse, N. Y., and shows just a little detailed view of a parsonage. Particular attention is called to the block. Here are more plain, straight forward concrete block. They are 12" high and 24" long and have a facing of bird's-eye gravel. The film of cement was removed by spraying with water when the block were fresh. The result is an interesting texture. They were made at the [illegible] Plaster Co. Fig. 2 shows the so-called "bush-hammered" block. It isn't bush-hammered, of course, but is made using a face plate which gives the effect shown. Fig. 9 shows a detailed view of a garage in Louisville, Ky., in which some panel and [illegible] the construction; the facing is of granite.

A Rough Surface—No "Cementy" Appearance

While the work shown in Figs. 10, 11 and 12 is not factory made concrete, the plates serve to convey an idea along the line of the possibilities of textures which may be useful in concrete products manufacture. The figures show a pergola at the Cincinnati zoological park. A great many architects, we believe, find fault with many concrete products because their chief characteris[illegible] that they are lusterless. Such fault can not be found with the columns used in the construction of the pergola. [illegible] cu. ft. of cement, 4½ cu. ft. of sand and 8 cu. ft. of creek gravel. This gravel is of an unusual quality as to color, but in this respect is not very much different from gravel which is to be found almost anywhere when screened and washed. The columns were cast in sheet iron forms which were wired together and removed after four days,



[illegible]

[illegible] It was used in turning out the original core for [illegible]

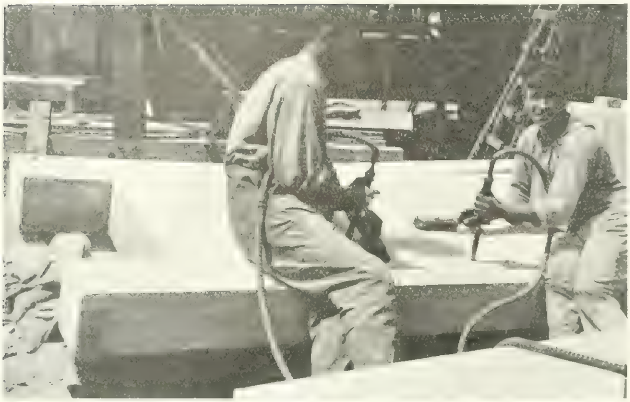


Fig. 13. Using Pneumatic Tools in Dressing Surface of Concrete Stone

when the concrete was rubbed down with a wire brush, thus exposing the pebbles and effectually removing any possibility of mistaking the columns for shafts of natural stone. These columns extend 5′ below grade and are 8′ high above grade. There are 42 of them in three double rows, arranged in a triangle.

Like the rest of the illustrations shown, Fig. 13 will serve merely as a suggestion along the line of possibilities which exist in the development of concrete building units which have real texture values. The plate was taken several years ago at the plant of the Neolithic Stone Co., Bridgeport, Conn., where concrete stone was dressed up, using pneumatic tools. The stone in the illustration was made with two mixtures, a surface mixture of Portland cement and feldspar chips and another coarse mixture for backing. This stone, made very wet, was used in the construction of a church in Providence, R. I.

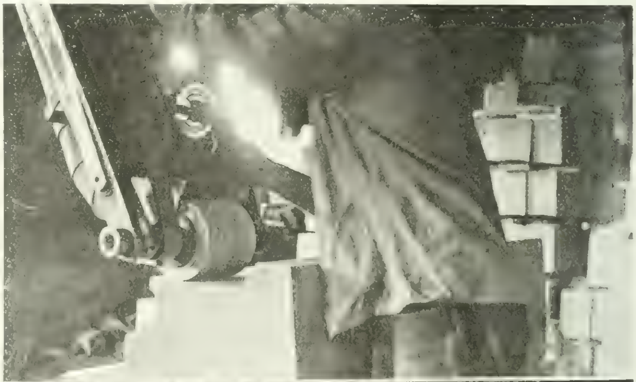
Concrete-Cement Age has already referred to the work being done by the Onondaga Litholite Co., Syracuse, in an article published in the Feb., 1913, issue. The cast concrete stone made by this company is produced in sand molds, but the real feature of the business is in the treatment of the stone after it comes from the molds. When the stone comes out of the sand it frequently looks as rough as that shown in Fig. 16, this plate having been taken at the Onondaga plant. About 24 hours after being cast, however, it is gone over with rasps, scrapers and wire brushes in the hands of common laborers. The sand adhering to the surface is removed, the rough spots are taken off and each piece of stone is brought down pretty close to a finished condition. It may be that this stone is to be turned out perfectly smooth without any tooling. If so, the block are turned over to skilled stone-cutters who handle the product exactly as they would handle a piece of natural stone. Some of the finished work, a pile of cornice brackets for a building in New York City, is shown in Fig. 14.

Fig. 17 shows stone, the design on which has been only blocked out to be finished by a stone-cutter, the detail to be carved by hand. This is done when only a few pieces of one kind are required. If many pieces of one kind are needed, a model is made complete in every detail and the finished work is merely dressed up by stone-cutters, lines being sharpened and the detail made more clear.

Fig. 18 is a view showing a surfacing machine with which cutting is done by means of a series of carborundum discs. This plate was taken at the plant of the Buffalo Litholite Co., although similar machines are used at the Onondaga Litholite Co.'s plant where they were originated and where the patents are controlled. These discs are mounted so that they hang on a suspended flexible arm, driven by overhead power. The framework which carries the discs supports a flue communicating with a fan above which sucks away the dust. The stone being finished is set up on bankers and as the grinding equipment is nicely mounted and balanced, it is readily moved along over the work.

Fig. 19 is from a plate also taken at the plant of the Buffalo Litholite Co. and shows an ornate capital which was cast in sand molds and is being recut and cleaned up by a stone cutter, who has, as his guide in this work, a plaster section of the original model. This is shown at the left.

The other views shown, that of the Queens Plaza Court, N. Y. C., Fig. 20 and those of the residence on Long Island, Figs. 21, 22, 23 24, and 25, illustrate finished work of the Onondaga Litholite Co. The stone used in the



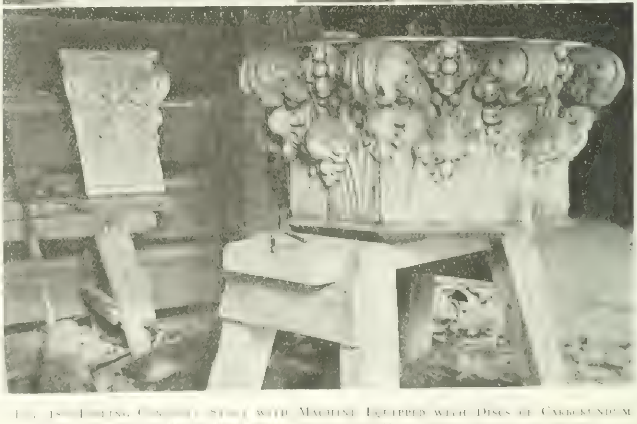


Fig. 18—Facing Concrete Stone with Machine Equipped with Discs of Carborundum
Fig. 19—Ornamental Capital Being Tooled by Hand After Casting in Sand

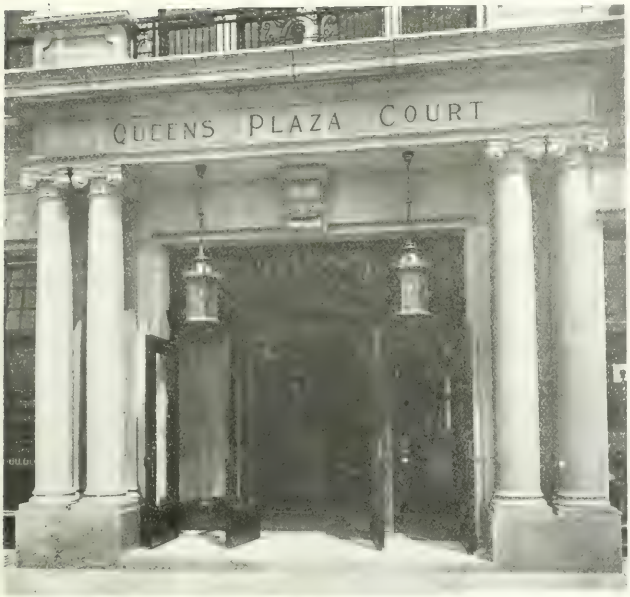


FIG. 20—QUEENS PLAZA COURT ENTRANCE, N. Y. C.; COLUMNS OF POLISHED GRANITE, ALL OTHER WORK CONCRETE

construction of the approach of the residence (Fig. 21) illustrates the effect of the tooling which has been described. An evidence of the quality of the stone manufactured is seen in the ornamentation above the doorway of this Long Island residence (Figs. 22 and 23). It will be noticed that the festoon is whiter than the surrounding concrete stone. This is because, when the picture was taken, it had just been carved by stone cutters. This carving was done after the piece was laid in the wall. This is true also of the panel immediately over the glass in the door, while the other stone work of mellower tone was finished at the factory. In Figs. 24 and 25 the stone is shown used by itself and in combination with dark brick.

Important Work With Concrete Stone

Further consideration of the products of the Onondaga Litholite Co., aside from surface treatment and architectural effects, seems worth while in view of the extensive use which architects are making of this manufactured stone for work of the best kind.

Work which the company now has in progress includes a large amount of cut stone trimming for the City Hall at Geneva, N. Y.; residence of Clarence Kenyon at Poughkeepsie, N. Y.; the Holy Ghost Convent, South Bethlehem, Pa.; Hamilton College, Clinton, N. Y.; St. John's Greek Church, Syracuse, N. Y.; Nurses' Home, Syracuse; Amsterdam Ave. Comfort Station, Park Dept., N. Y. C.; a public school in Rochester; Woman's University Club on E. 52nd St., N. Y. C.; Chemical and Physical Laboratory and the Army and Navy building being erected by the Bethlehem Steel Co., South Bethlehem, Pa.; Bellevue School, Syracuse; Volunteer Hospital, N. Y. C.; (to be built entirely of cut cast stone); additional buildings at the State Fair Grounds, Syracuse; a church at Manhassett, L. I.; and the 15th and 18th Precinct Police Stations, N. Y. C. The company has recently been asked to bid on 70,000 cu. ft. of stone for the Delaware and Hudson River R. R. office building. This structure is designed in elaborate Gothic style and will have about 820 linear feet of wall, four stories high with a tower 50'x62', 11 stories high.

These things are mentioned here as evidence of the fact that architects who are doing important work have come to a realization of the value of concrete stone, frequently in preference to natural stone, and sometimes at a slightly higher price than natural stone, because the artificial stone has been found to have peculiar values in resisting atmospheric conditions which frequently cause spalling and discolorations in natural stone masonry walls.

Mixtures Made With Care

It has already been detailed in CONCRETE-CEMENT AGE how the Onondaga company casts its stone in sand molds, but particular mention should be made of the care which is taken in the preparation and grading of the aggregate. Sturtevant[1] crushers have been installed which take 8-in. stone. This stone is Gouverneur marble and comes in white and bluish. It is brought in on a siding in car lots, most of the pieces usually under 8" in size. It is considered quarry waste. It goes through the crushers and is broken up to about ½-in. size and smaller. It is elevated to a tower and conveyed by gravity through Newaygo[2] ore separators where it is divided in four sizes—½" down to dust.

Anything which is larger than ½" is automatically returned to the crusher to go through a second time. After being separated, it goes into four bins from which it is conveyed by chutes opening directly above the mixer hopper. All of the aggregate used in the concrete stone is weighed and the water used in each mix is definitely measured. The mixture is not always the same and depends upon the particular kind of stone which it is desired to produce. The mixtures comes out of the mixer, which is a modified Ransome,[3] very wet and is conveyed, a yard batch at a time, into the agitator which has already been described. This agitator is mounted on an overhead crane and is equipped with a motor, constantly driven while the agitator contains concrete, so that the

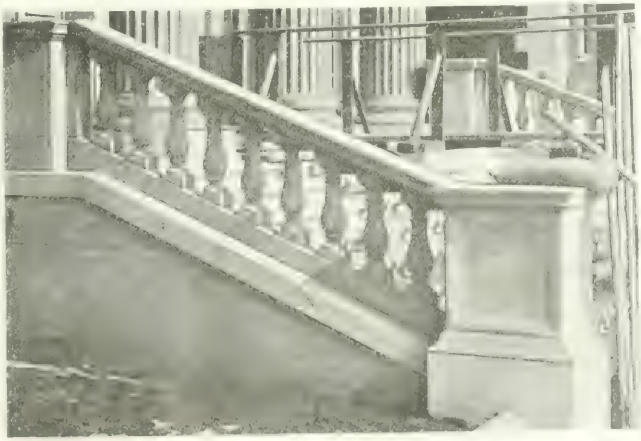


FIG. 21—DETAIL OF B[illegible] L. I. [illegible] TRIM IN CONCRETE

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[1] Sturtevant Mill Co., Boston

[2] Sturtevant Mill Co., Boston

[3] Ransome Concrete Mach'y Co., Dunellen, N. J.

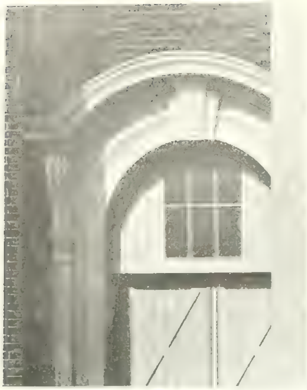


Fig. 2—Detail of Doorway of Cast Stone—Long Island Residence

mixture is kept well stirred up and goes through the 3-in. metal pipe into the sand molds in a like consistency to the very last spoonful of concrete.

In casting in sand, to prevent shrinkage around the edges at the top, wooden strips are put in the sand bed. In this way it is possible for men to go along a few minutes after the casting is done and trowel off the edges without disturbing the mold. This could not be done with the edges of sand. Furthermore, if the edges were of sand clear to the top, the shrinkage by absorption would be so great as to leave the stone imperfect on the top side.

Just before the stone takes its set, a tag with a wire attached, and bearing the description, number and destination of the piece of stone, is fastened to the casting by sticking the wire into the concrete. These tags went to the molding arm along with the pattern and when the mold was made in sand, the tag was stuck into the sand at the side of the mold so as to be ready when the casting was made. These cards also bear the name of the molder and of the finisher so that if anything goes wrong with the piece of concrete, the fault may be traced. In the manufacture of this cast stone, color is used on some work, but very sparingly. White is made using the natural white marble as an aggregate with ordinary gray cement. The stone with a blue cast is made using the blue marble to some extent in the aggregate and a buff stone is made using not more than 2% color. This gives a very light buff not more pronounced than a creamy tint.

Among recent cement patents is one for the making of cement or hydraulic lime from plaster, with sulphur dioxide as a by-product, this in turn being available for the production of sulphur. The patent is described as follows:

"An intimate mixture of calcium sulphate (gypsum, anhydrite, or plaster of Paris) and clay, with coal (10%), and ferric oxide (2%) is burnt in a rotary furnace and at the same time subjected to the action of superheated steam. The products of the reaction are cement clinker or hydraulic lime and sulphur dioxide."

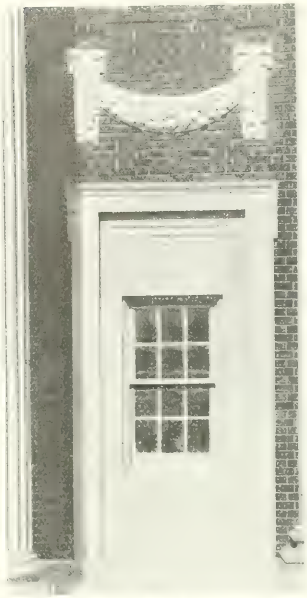


Fig. [illegible]—Cast Stone [illegible] Ornament [illegible] [illegible] Wood

Fig. [illegible]—[illegible]

Directors of the Northwestern States Portland Cement Co., and of the Southwestern States Portland Cement Co., met recently at Mason City, Ia., and discussed extensive improvements for the plants at Mason City and at Dallas, Tex. C. H. McNider, Mason City, is president of both companies.

Fig. [illegible]—Cast Stone Used with Dark Brick

Limits to Building Heights

There seems to be a reaction in American cities against sky-scraper erection. The following is a partial list of restrictions enacted recently by some of the principal cities in the United States:

Baltimore—Fireproof buildings limited to 175', and non-fireproof to 85'.

Boston—Two and a half times the width of the street, the maximum being 125

Buffalo—No height greater than four times the average of least horizontal dimensions of the building.

Chicago—An absolute limit of 200'.

Cleveland—Two and a half times the width of the street, with maximum of 200'. Recesses or setbacks to be counted as added to the width of the street.

Denver—Not to exceed 12 stories, and those more than 125' to be fireproof.

Jersey City—No building or structure except a church spire shall exceed in height two and a half times the width of the widest street upon which it stands.

Los Angeles—A limit of 150'.

Newark, N. J.—Not to exceed 200', but warehouse and stores shall not exceed 150'.

New Orleans—The height at the street line shall not exceed two and a half times the width of the street which the building faces. Setbacks are to be counted as added to the width of the street.

Paterson, N. J.—Warehouses and stores must not exceed 100' in height.

Portland, Ore.—All buildings except churches are limited to 150'.

Scranton, Pa.—The limit is placed at 125

Review of Concrete as a Fire-Resistant

In a paper recently read before the Boston meeting of the Am. Soc. of Mech. Engrs., G. E. Fisher, engr. of the Arkwright Mutual Fire Insurance Co., Boston, gives some interesting experiences with concrete in fire. He prefaces his remarks with the following general statement:

The fact that a building is of concrete construction seems to carry with it the idea that it is fireproof, regardless of occupancy. This word fireproof is a misnomer when applied to any kind of a building and it is gradually being displaced by the word fire-resistive, which includes not only concrete construction, but also the type now so common involving steel frame work protected with tile, concrete or brick. No building is absolutely fire-resistive, for the resistance offered to fire is one of degree only, and if the heat be sufficiently intense and prolonged, nothing can resist it.

At high temperatures the surface of concrete is easily injured and spalls badly when water is thrown on it, and both actual fires and experiments have proved that where these temperatures run from 1,400° to 1,900° F., the surface of the concrete may be injured to a depth of ½″ to ¾″, or even 1″, but the body of the concrete is not affected. Excellent heat insulation is afforded by concrete, but to obtain the best results a sufficient thickness must be applied, depending largely upon the occupancy of the building under consideration. Experience has shown that 2″ of concrete will protect an I-beam with good assurance of safety. Obviously a building having combustible occupancy should have a heavier protection of concrete over reinforcing members than one having non-combustible occupancy.

The best fire-resistive materials are usually considered to be first-class Portland cement with quartz sand and broken trap rock. Limestone aggregate will not stand the heat so well as trap and the particles of gravel are more easily loosened by extreme heat. Cinders make a good aggregate for fire resistance, but the concrete made with them is not so strong as the rock concrete and cannot be used where high compressive values are necessary. Considered from an insurance point of view, cinder concrete is not so desirable as that made of trap rock on account of the porous quality of cinders; the insurance companies have learned that with cinder concrete they are called upon to pay losses on account of damage from water used at times of fire, which percolates through the small interstices of the cinders, which the cement mixture cannot reach, to the floors below.

The behavior of concrete in the great fires in Baltimore and San Francisco as reported in the various scientific publications at the time of these conflagrations is again offered by the writer, who sums up the general investigations in both fires to the effect that concrete stood well in both cases even though the material used in San Francisco was of inferior grade and much of it flimsy material stiffened with light metal which had been passed as reinforced concrete. Coming down to a more recent period he says:

Reports from fires in other sections of the country furnish further interesting information. At the Dayton Motor Car Works, Dayton, O., and Huyler's building, N. Y. C., the fires were so hot as to destroy all inflammable material and yet the buildings themselves were damaged to a very slight extent only; the burned-out floors were occupied within two days after each fire. Another example is that of a two-story building of reinforced concrete construction used for drying purposes; this building was considerably exposed by frame buildings adjacent to it, and at the time the frame buildings burned, one part of the concrete structure was subjected to severe heat from a burning boiler house and grease-extracting building. The heat melted the wire glass in the windows and burned up all combustible materials in the finish of the building, but the damage to the concrete walls and floors was very slight. Still another case is that of a reinforced concrete building, four stories in height, in which the heat from a fire was so intense that it fused a piece of cast iron into a shapeless mass, but the only damage resulting was that in several places throughout the building the concrete was split off to a depth of ¼″ to 1″.

In the case of an extremely hot fire in a pulp and paper mill, the principal effect of the heat observed was to expand the floor and to cause a movement of the columns. On the morning after the fire, while the concrete was still hot, the end wall of the mill was noticeably out of plumb; later on, as the wall cooled, it drew back to the perpendicular. There were several minor breaks in the concrete and some parts of it were spalled off to a depth of about 2 ins. Where the concrete was rich in mortar there was less damage than where it was stony, the mortar acting as a protection to the aggregate. Where the fire was hottest the concrete was softened for an average of 1 in., so that it could easily be knocked off with an ordinary hammer.

Referring to the requirements of the Mutual fire insurance companies that sprinklers be installed in all manufacturing buildings having combustible material either in their construction or occupancy, he states that the use of these sprinklers has proven very effective. Instancing a case of this kind, he says:

Some interesting information was furnished by a fire in one of these fire-resistive buildings, which did not have sprinklers, by a fire that destroyed the contents. The building, which was occupied for general office purposes and had the usual fittings and trimmings of a modern office, was three stories in height with 17-in. walls of brick and had tile and reinforced concrete posts and beams on all floors. On account of its superior construction and safe occupancy, sprinklers were thought not absolutely necessary. The intense heat generated by the burning of the hardwood overlay on the floors and the hardwood office fittings affected the brick walls, the concrete windowsills, and the concrete belt extending around the building at the third floor level. It is thought that most of the spalling of the concrete work was due to cold water from hose streams on the hot material. The structural strength of the concrete columns appeared to be very much reduced by the fire, and to determine whether or not it was necessary to replace them and the beams damaged in the fire, shores were placed under a third floor beam ½ in. clear at the top, to take the weight, should it settle when loaded. Careful measurements were taken of the distance between the underside of beam and top of floor below. A load of 16 tons of iron was placed on the third floor over the beams to be tested, and the deflection was 7/64 in. in the center of beam. This occurred at once when the load was applied, and did not increase when the test continued, namely, 3 hrs. For comparison, the same load was then placed over an uninjured beam elsewhere, and the same measurements taken, showing a deflection of 6/64 in., or practically the same as found in the damaged beam. No settling could be detected around any of the damaged posts when the load was applied.

In repairing this building a cement mixture was made and the beams and columns built out with it wherever spalling had taken place. It is doubtful that anyone examining the building today could detect any traces of this fire. It has been equipped with automatic sprinklers, and as a further precaution against another fire the new office furniture is all metal so far as could be obtained. From the writer's own experience, however, he would not consider this last precaution necessary, for in a building well protected with sprinklers the chance of a fire getting outside the area of two or three sprinklers is remote.

Construction Development in Bombay

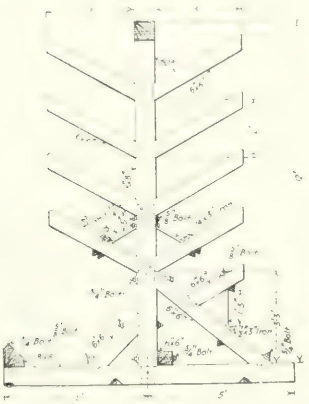
Statistics for the past five years show a steady record of building activity in Bombay, India, the minimum number of permits issued being 3,198 in 1910 and the maximum being 3,827 in 1909. A recent issue of the *Daily Trade and Consular Reports* states that building stone has lately risen in price, and dear timber is responsible for a heavy demand for steel beams, pillars, and girders from the United Kingdom and Germany; both countries, notably the latter, are shipping larger quantities of iron and steel building material into Bombay. Imports of cement have advanced 34% in quantity and 52% in value.

The abnormal rise in the price of teakwood in India will probably introduce in a gradual way a new system of construction, together with a number of time and labor saving improvements. For building operations heavy teak beams are giving place to beams of steel, as there is no other timber available in India which possesses the resisting power of teak against white ants and rot.

Reinforced concrete structures are now seen in different sections of Bombay, and are likely to be the basis of a new system of building adapted to such uses as tenements, warehouses, and structures for light manufacture.

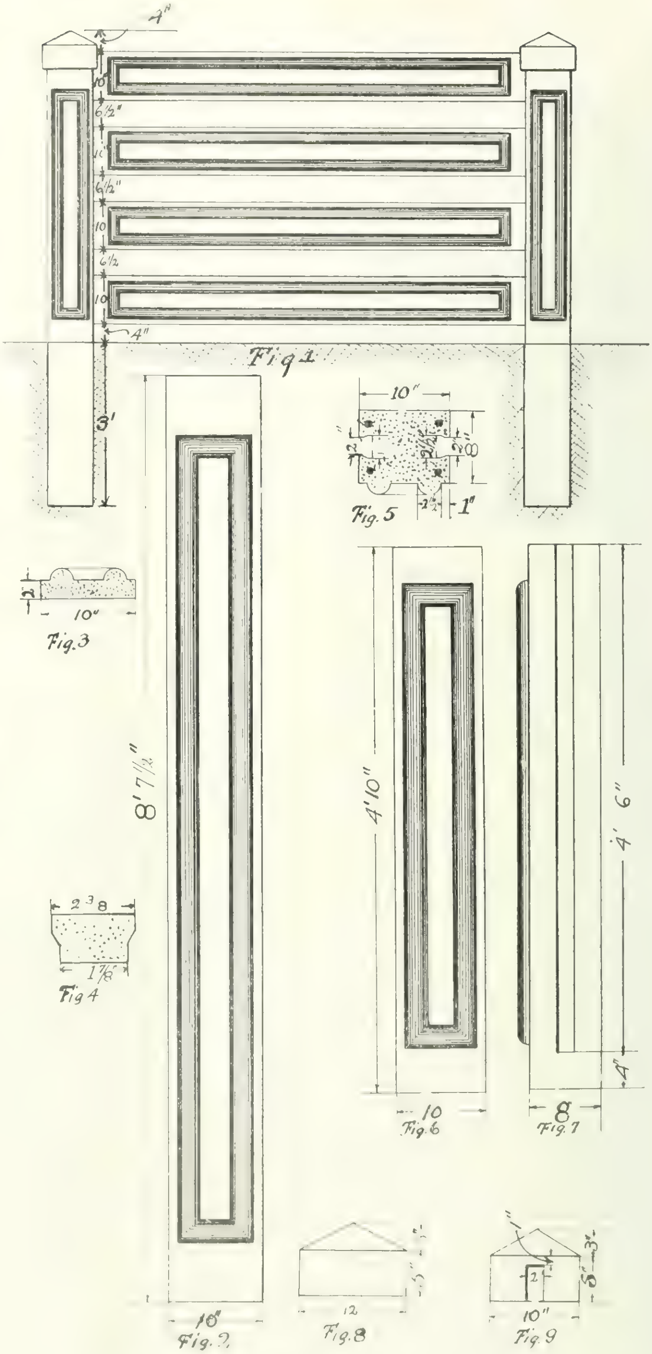
A Simple Rack for Reinforcing Steel

On many occasions writers in these columns have pointed out the absolute necessity of keeping reinforcing steel up out of the mud and dirt after it is brought to the work. The usual method is to sort the steel on the ground, laying it across stringers. In many instances, however, space is very limited and some other method is desirable. In a recent issue of the *Engineering and Mining Journal* the accompanying sketch is used to illustrate a pipe rack for the mine warehouse, which would do admirably for storing reinforcing. This rack is substantially built and would probably cost money, but where a contractor is doing work around the city where space is always limited, such a set of racks, possibly three or four, which could become a permanent part of the equipment, would save its cost several times over. The detail of the rack is given in our contemporary as follows:



Sketch Showing End View of Pipe Rack

The rack as shown, consists of a number of bents spaced 4' apart. Six bents would thus give a length of 20', sufficient to accommodate standard pipe. Five bents would probably be just as satisfactory. Each bent consists of a center post 8" x 8", with inclined pieces 6" x 6" symmetrically placed on each side. The base is an 8-in. x 8-in. by 10-ft. piece and suitable bracing is provided at the bottom. The line of bents is tied by a horizontal 8" x 8" piece along the top of the center posts, a 6" x 6" piece at its bottom and an 8" x 8" chamfered piece along the ends of the bases. The upper diagonal arms should be supported by iron braces similarly to the lower set, although these are not shown in the illustration. These 6" x 6" diagonal arms should also be mortised into the center post with either inclined or square mortises, as shown on the lower two sets.



[illegible]

[illegible]n; Fig. 2, Elevation of Rail; Fig. 3, Section of Rail; Fig. 4, Section of Spacing Block; Fig. 5, Section of Post; Fig. 6, Side Elevation of Post; Fig. 7, Front Elevation of Post; Fig. 8, Front Elevation of Cap; Fig. 9, Side Elevation of Cap

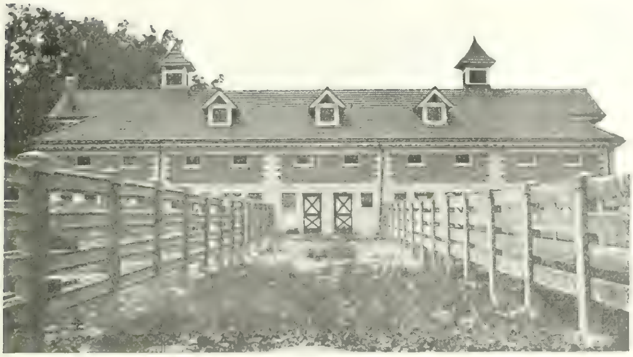


Fig. 10—Unit Built Concrete Fence Used for Bull Paddocks

Fence of Concrete Posts and Rails

Much has been said from time to time about the extensive use of concrete at the Anna Dean Farm, owned by Ohio C. Barber, Barberton, O. Mr. Barber is building practically everything to last and is sparing no expense in doing this. One rather elaborate idea which was worked out by the Concrete Department on the farm is a fence consisting of reinforced concrete posts and rails, several miles of which have already been built. This fence was described in the February, 1912, issue of *Concrete.* Since then improvements have been made on it, particularly in the way the rails are held in position in slots in the post. Fig. 1 shows an elevation of a complete section of the fence. Fig. 2 shows one of the rails. These rails are 10" high, 8' 7½" long and 2" thick, not including the molding. A section of the rail is shown in Fig. 3, and Fig. 4 shows a section of the spacing block which is used in holding the rails in position in the slots in the posts.

Just how this works may be seen by examining the section of the post which is shown in Fig. 5. The blocks are made so that they dove-tail in the slots and are dropped in from the top of the post before the cap is put on. The reinforcing consists of 4 ½-in. square twisted rods. A front view of the post is shown in Fig. 6 and a side view in Fig. 7. Not including the molded panel, the posts are 8" x 10" in section and 4' 10" above ground. Details of the caps for the posts both front view and side view are shown in Figs. 8 and 9. Fig. 10 shows some of this fence constructed for bull paddocks at the Barber farm.

The trouble with the original fence as built two or three years ago was almost entirely in the spacing blocks used between the rails. The slots in the posts were straight, not dove-tailed, and it was attempted to hold the rails in position in the slots merely by little wooden blocks. These blocks began to work out of place when they had gone through one winter and P. E. McAllister, who since became manager of the Concrete Department, devised the new post and the dove-tail blocks, which seem satisfactorily to have solved the problem of a permanent means of holding the rails in position. The posts cost to manufacture and set up $1.05 each and rails 50c each. This is on a basis of 50c a yd. for gravel.

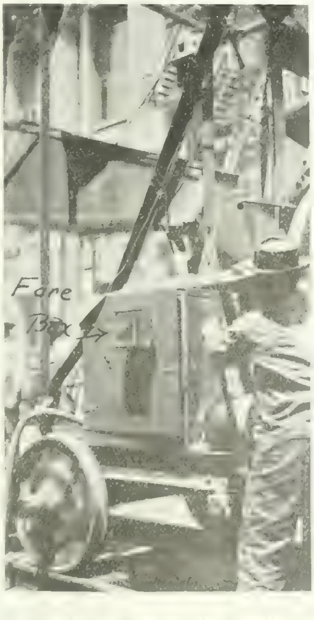


Fig. 1—An Old Fare Register Attached to the Housing of the Engine on a Street Mixer and Used to "Ring Up" the Batches

Devices for Ringing Up the Batches

In watching some track work recently an ingenious device for keeping count of the number of batches run was noticed. To the housing of the engine an old fare-register was attached with a cord handy for the mixer operator, and every time the mixer was dumped the batch was "rung up." This was on track-bed work for a street railway, so that a fare-register was especially appropriate.

Another device noticed on other work was a board hung up over the mixer. The board was 12 in. or 14 in. wide and 24 in. or 27 in. long with a rounded top and a hole so that it could be hung on a nail. On the base of the board in two quadrangles small ¼-in. holes had been bored about 1 in. apart, 10 holes each way, so that there were two blocks of 100 holes each. A little wooden peg which was attached to the board with a string was the count and was moved over one hole each time a batch was dumped. This is a direct reading counter, and one that might prove useful on many concrete jobs.

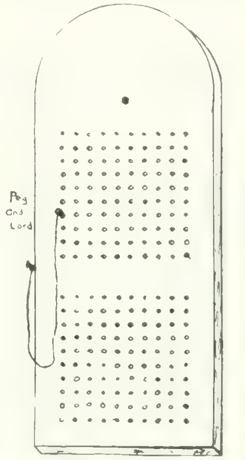
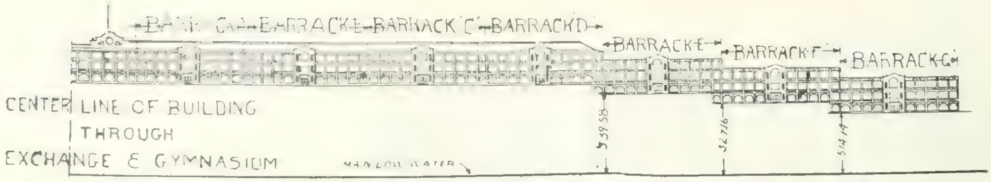


Fig. 2—Sketch Showing Arrangement of "Score Board" to Keep Tally on the Batches

Protecting the Edges of Concrete Curbing.

The edges of concrete curbing may be protected against chipping by means of iron rods or tubing placed in position as shown in the sketch which is reproduced from a recent issue of *Popular Mechanics.* The anchoring wires are shown at the left, *A* being the twisted type and *B* the hairpin anchor. The rods are held in the forms while the concrete is being poured with wires *CC*, which are cut close when the forms are removed. The finished curb is shown at the right.

[illegible]



[illegible] Section [illegible] of the Barracks Recently Erected on Corregidor Island, Manila Bay

A Half Mile of Concrete Barracks

U. S. Soldiers live in fireproof quarters on Corregidor, Gibraltar of the Orient

BY R. McC. BEANFIELD*

On Corregidor I., in Manila Bay the U. S. Government has built a barracks 2,100 ft. long. Reinforced concrete was used throughout. The following article, by the superintendent on the work, describes the methods and materials used.

The barracks at Ft. Mills, Corregidor I., Philippine Is., consists of a line, 2100′ long, of reinforced-concrete buildings directly connected to each other by passageways, virtually making one long, monolithic building. All the barracks are alike except the Post Exchange building in the center. The buildings are stepped off at the different levels at passageways between the sections, one side of the passageway being an L-shaped retaining wall.

Location

The barracks are located at an elevation of 552′ above mean sea level, at the top of the largest hill in the center of the island, the barracks being surrounded by the various large gun emplacements. The buildings were stepped off to fit the natural ground contours of the hill, thus saving much excavation and filling.

Excavation

The ground for receiving the foundations consists of a clay conglomerate of volcanic origin, and in times of heavy rain fall becomes very soft and unreliable for suitable foundations.

The locations of the barracks on the 552-ft. contour level necessitated heavy excavation, in some places there was over 20 ft. of cut. Most of the material required blasting and then was taken out by the ordinary pick and shovel work, loaded into Koppel industrial cars[1] and dumped over the slope to increase the width of the grade. Numerous spalls of trap rock were excavated, saved, and later used for concrete work in the buildings. The labor used for excavating, consisted of 250 native civil convicts, and two native "capataz" or foremen. The convict labor cost the military authorities, 4 cts. per convict, per day.

Concrete Materials

Rock for concrete work was first obtained in a quarry on the side of Malinda Hill, about a mile from the site of the barracks, hauled by an industrial railroad to the foot of a cable way, then to the top of the hill and again taken by industrial cars to the building site.

The rock in this quarry consists of a soft limestone, requiring a good deal of explosive to mine it. After being crushed the product consisted of much dust and screenings; the dust was especially objectionable for concrete and with difficulty was washed off the rock by ordinary means. The method used to wash the dust off the rock was to punch holes in the bottom of the wheel-barrows that carried the rock to the mixer, and play a hose on the rock while it was being shoveled into the wheel-barrow, the dust and water draining off the rock through the holes in the bottom of the wheelbarrow.

In the opinion of the writer this rock from below the hill was not desirable for concrete work due to its softness and large amount of dust and screenings after being crushed. On the other hand the innumerable spalls of trap rock which were taken out during the excavation for the building site could have been secured at less cost than the limestone mined at Malinda Hill; it was besides a "snapper" rock to crush. Howev-

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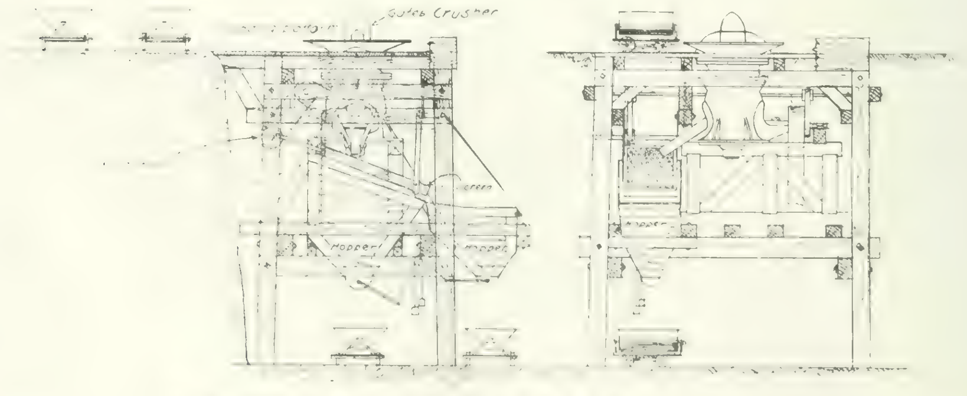
*[illegible]

[1] Manufactured by Arthur Koppel Co., Pittsburgh, Pa.



[illegible] Sections of Crushing Plant Used in Preparing the Concrete Aggregate

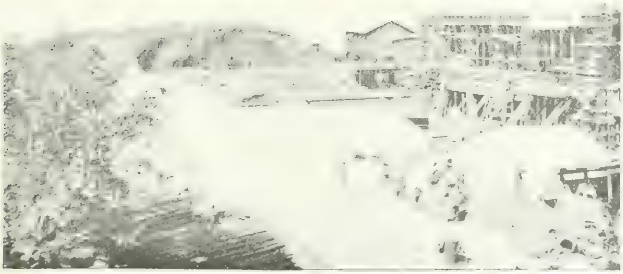


Fig. 3—In the Background is Shown the Excavation Proceeding for a Barracks. [illegible] Right, [illegible] is Shown the Mixing Gang. It will Be Noted That the Laborers are in Convict Garb

er, not till after 50% of the building work was completed were the spalls used. A crusher (Gates[2]) was installed by the side of a small hill on the building site left unexcavated. An industrial railroad was run up an incline to the top of the hill and the cars dumped the rock directly into the crusher which was steam driven.

The rock fell from the crusher to an incline screen directly below the crusher. The screen segregated the rock to the proper size, the small size falling through the holes in the screen and the large size was shaken off the incline screen by the motion given to the screen by a connecting rod to an eccentric with a 7-in. throw. After a little experience it was found that a slope of 35° given to the screen would produce the best results. The product of this crusher could be delivered at the mixer for about half the cost of the rock from Malinda Hill.

Sand was obtained from Carabao I. This was sea sand, consisting of very fine grains and about 12% of sea shell. The sand was not as good as desired, but the cost of other sand was high and it had to be obtained from Manila in scows at uncertain times, and so could not be used.

Three brands of cement were used at different times during the construction of the building, namely: Atlas, Hyphong, and Green Island; Hyphong (Dragon Brand) and Green Island are foreign made cements procured from Hong Kong.

Work was started in July, 1910, on the foundations of barracks A, B and C, to the left of the Post Exchange building; while the sites for the other buildings were being excavated to grade. No forms were used for the footings but were used for the foundation piers.

Mixing Plant

The rock and sand were deposited in piles beside the mixer and were taken to the mixer in wheelbarrows. Ransome ½-cu. yd. mixers[3] were used and proved to be very efficient mixers. Native convicts fed the mixers and did general roustabout work. Two concrete hoisting towers for every three buildings were erected and [illegible] by [illegible] drum Lidgerwood [illegible] midway between them.

The mixer dumped into an automatic Ransome dumping bucket which was hoisted to a hopper on the tower where the concrete was taken by wheel-barrows to the forms; but later the writer developed a more efficient method of handling the concrete by placing track and 1-yd. Koppel cars directly on the form work, using turntables to change direction in the track lay-out. In the large columns (18 x 18 [illegible]) concrete was dumped directly into the forms but for the smaller columns the concrete was dumped on the floor slab form and shoveled into the column. Later the writer again devised a still more efficient sys-

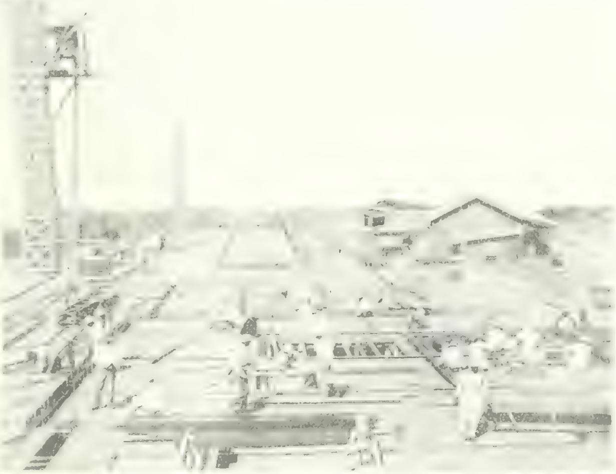


Fig. 4—This Shows Forms for Piers and Beams, [illegible] and Barrows

In this work industrial cars [illegible]

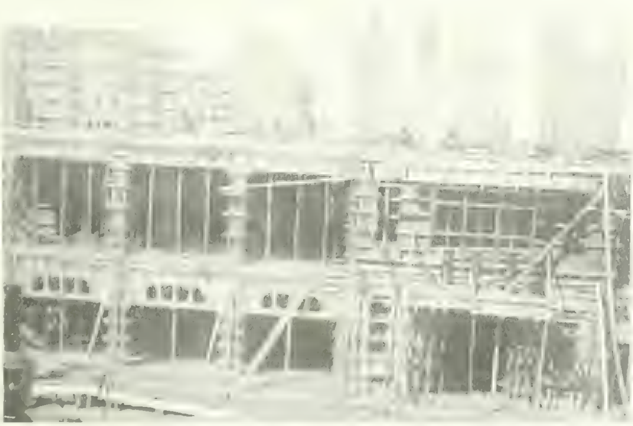


Fig. 5—[illegible]

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[2] Allis-Chalmers Mfg. Co., Milwaukee.

[3] Ransome Concrete Machy. Co., Dunellen, N. J.

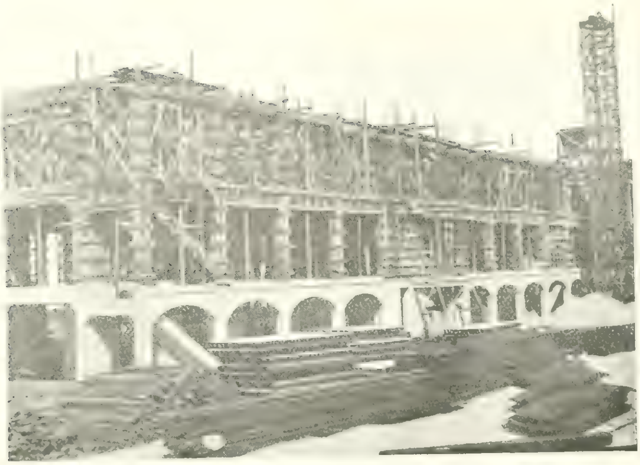

Fig. 6—This Shows the Centering Complete for the Third Floor

This is at the end of one barrack and the rods projecting for the next barrack can be seen at the left

tem for handling the concrete by using a gravity chute in connection with the industrial cars. The chute controlled all the forms within a 150-ft. radius of the tower; farther than this the chute dumped into the industrial cars.

The Chute Used

The chute, for which a patent is now pending, was made in sections 9′ long, of 18-ga. sheet iron bent to the shape of a half cylinder trough opened on top and stiffened by placing ⅜-in. rods, clamped along the top of the sides, 24″ o. c. The chute was attached to a 1¼-in. manila rope by bridles of No. 9 wire. Each section was connected to the other by passing a ⅜-in. x 1-in. bolt on each side of the trough, near the ends, through the lapping parts. The 1¼-in. rope was roved through a single block located at the top of the hopper and then to the ground beside the tower. Any inclination of the chute could be obtained by hauling on the rope at the base of the tower. It was found that the chutes would work at a minimum inclination of 12° and that the best results could be obtained at an inclination of 30° to 40°. Factors involved in this operation are the amount of water used in mixing, the distance the concrete has to travel and the method of hanging the chutes, whether hanging in a catenary or stretching the rope very taut so as to allow very little sag. The writer gives the chute a little sag because the concrete can be controlled better at the discharge end.

At times an average of 150 cu. yds. to 180 cu. yds. a day of eight hours was placed, using only 15 natives to load the mixer, one tower man at the hopper, and two men to handle the end of the chute, and five men to puddle the concrete in the forms. When both mixers were running, a record of 305 cu. yds. in place was made in eight working hours, one hoisting engine being used for the two towers.

The Form Work

All the forms were made of Oregon pine. At first No. 9 wire was used for tying the forms together but it was found that the wire stretched and sunk into the outside braces, thus allowing the forms to bulge. However, the writer later developed the use of ½-in. bolts made from scrap pieces of ½-in. round reinforcing steel, threaded on one end and bent at right angles on the other end. All columns and wall forms were set on 2-in. x 4-in. or 3-in. x 4-in. plates first set accurately to line. In this way accurate work was obtained and easily checked.

Forms for the first story of three buildings were first erected and followed by forms for the second story, but for the third story the writer had intended to use the forms on the second story as the second and third stories were similar in construction, but the authorities would not allow the forms to be taken off the poured parts for over 40 days so that a complete set of forms for the third story had to be made.

Partitions of 3″ and 4″ were poured, instead of plastered, using a 1:4 cement mortar reinforced with Hy-rib[5] and ¼″ rods. The partitions were constructed 20% cheaper by pouring and a very good finish was obtained by floating the day after the pouring. Plastering with native labor gives very poor results as well as much loss of time and the probability of cracked partitions.

Window and Doorway Frames

False frames were left in the forms and later ipil frames, a native wood, were inserted in their place and anchored by screws to blocks wedged into the wall. Later the frames were set in the forms and nails driven in to the concrete faces of the frames to anchor them to the concrete.

Roof Construction

The roofs of all the buildings on the 552-ft. level were covered with a red reinforced-concrete patented tile supported by steel trusses of the fan type. The roofs on the other levels were all of concrete. The tile were made on the building site and are especially commendable due to their great strength, water-tightness and ease of laying.[3]

Labor Conditions

The number of men employed on the construction of the barracks averaged about 400, although at times there were more. Most of the carpenters and cement workers were Filipinos and the rest consisted of Chinese. Filipinos did faster work in setting and making forms but the Chinese did better work in making and setting of door and window frames, being very good in joinery work.

At first many Americans were employed but within two months the American force consisted of the writer who was superintendent, one carpenter foreman and at times one concrete foreman. Due to the strict regulations of the military authorities and the constant delays and changes in the construction, many Americans became discouraged and would not remain.

At times rush orders would be given and the force of native carpenters had to be increased beyond reason and the whole organization would be congested, with the result that after the rush was quieted down a number of men had to be let out. This caused much dissatisfaction among the natives, as the Filipinos are great people to form cliques. They usually have many relations always with them so that if one is discharged the whole family go. In this way the labor situation was constantly hampered and men who were trained at considerable effort would leave the work. Following is the labor schedule covering the personnel authorized by the Quartermaster's Dept.:

			Per Day
1—Supt. of Const., at		....	$5.77
1—Carpenter Fm.,	1st Class,	at ...	5.77
1— " "	3rd "	" ...	4.19
1—Concrete "	1st "	" ...	5.12
1—Carpenter "	(Chinese)	" ...	2.50
1— " "	(Native)	"	1.00
" "	(Chinese)	" ...	1.50
" Native,	1st Class,		1.25
" "	2nd "	"	1.00
" "	3rd "	"	.75
3—Concrete Fm.,	1st Class,	"	1.50
[illegible] "	2nd "	"	1.25
[illegible] Labor Foreman,	2nd "	"	.75
[illegible] Laborers	1st "	"	.60
[illegible] "	2nd "	"	.50
[illegible] Masons	1st "	"	1.00
[illegible] "	2nd "	"	.75
[illegible] Watchmen			[illegible]
[illegible]			[illegible]
			Per Month
[illegible] Storekeeper,	2nd "	"	$20.00
[illegible] Timekeeper & Asst.		"	[illegible]
[illegible] Watchmen	2nd "	"	[illegible]
[illegible] Messenger		"	15.00

One feature of the work was the use of ordinary building paper to cover cracks on the floor slab forms. The

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[4] Lidgerwood Mfg. Co., N. Y. C.

[5] Trussed Concrete Steel Co., Detroit, Mich.

[3] Patentees of this tile are Fressel & Co., Manila, P. I.

forms after being used and subjected to the tropical weather developed large cracks which prohibited their future use. The writer, however, experimented with building paper, which proved so efficient that this method was used on all future work where conditions would warrant it.

Standard Cross-Sections and Symbols

The committee appointed by the Am. Soc. of Mech. Engrs. has recently submitted a report covering the use of standard cross-sections and symbols. It has often been said that mechanical drawing is the language of engineering. While this is true to a certain extent, yet it remains as a general fact that it is a language without uniformity, without grammar, and filled with dialects and peculiarities of expression. Any endeavor to conventionalize and standardize cross-sections and symbols used in mechanical drawing should be of the greatest value to the engineers and the construction profession as a whole.

The accompanying illustrations show standard cross-sections recommended for standard building materials. Fig. 2 shows how these standard generic symbols can be varied to represent subdivisions and different applications of the same material.

In a bulletin recently sent out by the Am. Soc. of Mech. Engrs. the report of the committee was critized and discussed from a good many standpoints. The report, however, as submitted seems to be very comprehensive and, as it should be, simple. Further developments will be watched with interest.

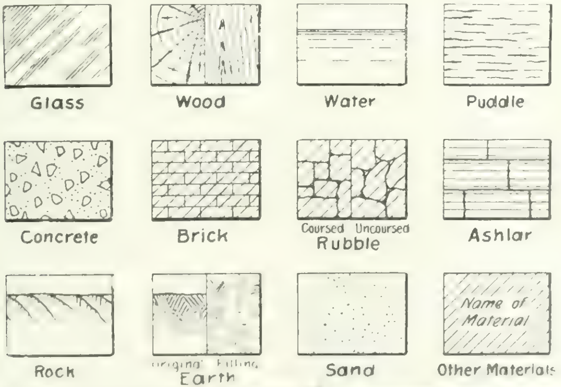

Fig. 1—[illegible]

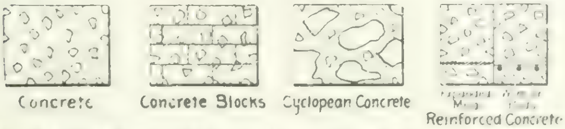

Fig. 2—This Shows the Way the [illegible] Standard [illegible] Can be [illegible] Various [illegible] of Materials

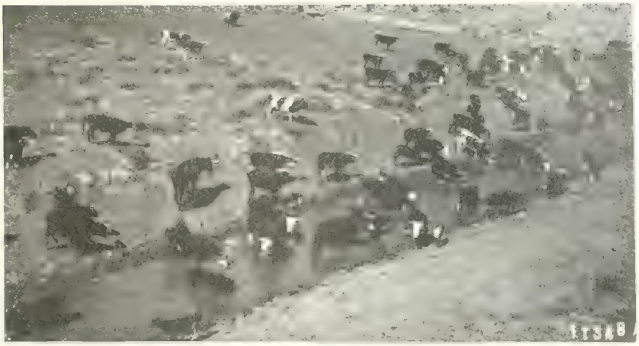

Fig. 1—"Wet Weather Water Holes" As They Have Been Abused in Arizona

From a height of ten feet above the present level this "wet weather water-hole" has been worked down by evaporation at the rate of from ½" to 1" daily and by watering the cattle, each of which consumes from 8 gals. to 10 gals. per day. Concrete lined reservoirs or tanks are recommended by the government to prevent the waste of water by absorption into the ground

Concrete in the Grazing Country

In the grazing country of the Southwest concrete troughs conserve the water supply, and make possible grazing over territory which, without such water supply, would be of no value.

Exhaustion of the "wet weather water-holes" in northern Arizona, on the watershed of the Grand Canon of the Colorado, threatens the extinction of immense herds of cattle and horses and flocks of sheep, with an attendant loss to the stockmen of millions of dollars. No snow fell over the region last winter or the winter preceding and the rainfall has been far below normal. The desultory showers of the month of July provided a quantity of water that, under the prevailing rapid rate of evaporation from ½" to 1" per day could not last more than 24 hrs. Last year's loss of half a million sheep, valued at $2,000,000, or, even, the ruin of the great drought year of 1892, it is now feared, may be again experienced by the stock interests.

Danger of Drought

So grave has the situation become that the government has taken stringent measures to prevent the overrunning of the National Tusayan forest by the vast droves of stockmen who do not hold grazing permits, while all means known to science are being taken by the Federal authorities for the conservation of the little water remaining on the reservations. A special report has been prepared by the U. S. Forest Service on "The Development and Improvement of Stock Watering Places in the National Forests," in which the construction of concrete tanks and troughs is urged upon the licensed stockmen, in place of the primitive and wasteful dirt water-

[illegible]

These indestructible concrete watering [illegible] luted the limited supply of water on the average Arizona range, and which are rapidly [illegible] using it [illegible] pended for watering their stock.

The special report of the Forest Ser-[illegible] Will C. Barnes, Inspector of Grazing, recounts the fact that in the early days of the western range stock business, so long as the ranges were not crowded, there was little thought given to the question of water supply. As the herds increased in numbers, the report continues, the ranges began to fill up and the animals were forced to go farther back into the unused ranges until it became necessary to secure more water for them. Very early in the business the stockmen learned that of two ranges, one with plenty of grass and forage and a short water supply, and another with plenty of water and rather less grass and forage, the latter was in the long run the more satisfactory range, provided always that the overstocking of the ranges could be avoided in each [illegible]

Water More Important Than Grass

When the ranges in the lower open regions became crowded the stockmen gradually worked their way into the higher mountains where the natural watering places, the springs, creeks, seeps and lakes were at first sufficient for all the demands of the range stock until the areas about each watering place were overstocked, overgrazed, and the animals forced to go farther and farther for feed. This congestion at certain places worked great damage to some of the watering places, especially the springs and seeps, which in many cases became mere bog holes where the animals could not obtain sufficient water for their needs and where what they did get was muddy and foul. Also the supply from such springs decreased considerably when the ground about them became trampled, the walls broken down, and the stream flow interfered with; in many instances they failed completely.

Where these supplies of water were upon privately owned land, the stockmen often dug them out, fenced up the sources, curbed the walls of the springs either with stone, cement or logs and led the water from the springs to troughs, dirt tanks or reservoirs. Where they were upon the open government land little was done toward improving them, because in the majority of cases the work could not inure to the sole benefit of those doing it and few cared to do it for the public good. * * * * With a more rational and scientific use of the stock ranges in the National Forests comes a necessity for more and better stock-watering facilities.

A summary of a number of estimates made by Forest Service officials covering the consumption of water by animals gives a daily average demand by the several classes of live-stock grazing on the National Forest ranges and on contiguous lands as follows:

Cattle, 8 gals. to 10 gals.
Sheep, ½ gal. to 2 gals.

According to the special report, a full and easily reached supply of water is quite as necessary to the range stock if the animals are to thrive and bring profitable returns to their owners as is the supply of grass and forage.

They cannot be fattened and turned off in a marketable form without both, but if it is merely a question of living through the year and not fitting them for market, a short grass supply causes far less demands upon their vitality and power to live through hardships than a short water supply.

Use of Concrete Troughs

The efforts of the Forest Service have been directed toward the conservation and increase of the water supply. Where grazing is a source of income and the needs of the stockmen are urgent, more of such work has been undertaken than in those forests where the timber sales and protective questions call for a larger share of the improvement funds. The Tonto and Tusayan Forests in Arizona have been the scene of radical improvements and there concrete watering-troughs have been found greatly to better range conditions, from the viewpoint of both the Service and the stockmen.

The average cost of these concrete troughs, with a capacity of about 500 gals. each, was $58.40, the report continues, which includes the cost of installing troughs and improving the springs. They are there forever, need but little or no attention or repairs, and undoubtedly have long ago more than repaid their cost. * * * * The cost of some of the better types of reservoir has been very great, but their actual value as an investment is far beyond their cost. Instances of reservoirs costing not over $1,000 being valued in sales of stock at from $2,000 to $10,000 are not unusual. On the Tusayan Forest the average cost of about 76 reservoir watering places is estimated at $350 each.

Whenever a new watering place is opened up or a hitherto insufficient supply is increased, the benefit is not wholly confined to the grazing use of the area, but the fire protection plans of the forest are also materially strengthened and improved.

With a constant and increasing demand for range for stock-grazing purposes, and face to face with a like increasing demand for meat products, the question for the Forest officer to consider in the future is not only how the ranges already in use can be utilized to their full capacity, as it is today understood, but how much further that capacity can be increased by any practical means. There is also the question as to ranges which are today for one reason or another unused and apparently not usable. On almost every forest range of any considerable extent are areas which either lack sufficient water for their full utilization or whereupon the location of water is so poor that the distribution of the stock is not satisfactory and the ranges are overcrowded in the immediate vicinity of the watering places—areas which might bear their full [illegible] are left almost untouched. This can be remedied only by adding to the water resources of the ranges.

Thus by the agency of a material that has proved of the utmost value to industrial and building interests elsewhere in the country may the southwestern problem of water scarcity, so vitally related to the national economic problem of the rising cost of provisions, find at least a partial solution.

Ocean to Ocean Highway Promoter Tries Concrete

On the Meyer road northwest of Indianapolis, beyond Riverside Park, there has been placed in front of the home of Carl Fisher, one of the promoters of an ocean-to-ocean highway, 170′ of concrete pavement 30′ wide. The concrete was made of a 1:2:3 mixture, 7″ thick at the center, 6″ thick at the sides, with a crown of 6″, having a 6-in. crown in order to join to the macadam road properly. Style No. 29 triangle mesh[1] was used for reinforcing and was placed 2½″ from the surface of the concrete. Baker[2] plates were used in the expansion joints which were filled with tarred building paper, making about a ⅜-in. joint. The joints were in the first place supposed to be placed every 25′ across the pavement, but due to some difficulty in getting the work started properly, they were placed as follows: 1st joint at 8′; 2nd at 17′; 3rd at 25′; 4th at 30′; 5th at 30′; 6th at 30′. Where the concrete joined the macadam there was placed a single steel plate.

The materials used in this construction consisted of washed sand and gravel of an excellent quality, coming from the large gravel plant of the Indiana Fuel Supply Co., Indianapolis. The concrete was placed wet and struck with template, and the surface afterwards floated, to get as smooth a finish as possible using an ordinary wooden float.

The equipment for this work was such that the result was a rather high cost of construction. The amounts of materials used to complete the work are as follows:

Cement	203 bbls.
Sand	61 yds.
Gravel	91 yds.
Reinforcing	5,750 sq. ft.
Baker Protector Plates	420′

The total cost was $465.58 which includes the price of reinforcing, Baker plates, labor of placing, and the cost of hauling materials, but it does not include the price of sand, gravel, or cement on board cars Indianapolis. This reduces to a unit cost of approximately 82 cts. per sq. yd. The work was watched closely by Mr. Fisher and he expressed himself as being entirely satisfied with concrete as a paving material.

Monarch Cement Co. directors have elected the following officers: Pres., H. F. G. Wulf; vice-pres., F. Kreitzer; secy., A. H. Nossaman; treas., F. H. Rhodes. The officers have taken charge of the plant at Humboldt, Kans., and the mill is again in operation.

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[1] American Steel & Wire Co., Milwaukee
[2] R. D. Baker Co., Detroit

Tests of Three Types of Floor Arches

Cinder concrete is always ready to stand on its proven merit as a fire-resisting material. The test described below brings out in direct comparison the fire-resisting ability of cinder concrete, terra cotta, and gypsum.

A fire, water and load test of floor arches was conducted by Harold Perrine, of Columbia University, on July 30 and 31, at his testing station at Greenpoint, Long Island City. The test was arranged for and the expense was borne by Albert Oliver, of the Clinton Fireproofing Co., 101 Park ave., New York, in accordance with an offer made by Mr. Oliver at a recent public hearing of the Building Code Committee of the New York City Board of Aldermen.

The system which was tested formed the roof of the test house, which structure is essentially a cinder-concrete oven of permanent construction. Properly supported upon piers 2½' from the ground is a grate composed of railroad rails and wire mesh, about 280 sq. ft. in area. The vertical distance from the grate to the roof is about 9½ ft. The floor system to be tested is supported by steel I-beams resting on the top of the walls, spaced at distances suitable to the span or spans under test, and having a clear span themselves of about 14 ft. Ample draft openings and flues are provided to facilitate the control of the fire.

The structure, as well as the methods used in the following test, conform with the specifications adopted by the Bureaus of Buildings, N. Y. C., and by the Am. Soc. for Test. Mat.

Method of Construction

The floor system under test was comprised of three separate and distinct types of arches, i. e., cinder concrete, terra cotta and gypsum.

In the first or west bay, was installed a4-in.slab, 5'-3" in span, of a 1:3:5 cinder concrete, mixed medium wet and reinforced with electrically welded wire reinforcement[2].

In the second bay was built a side construction terra cotta arch 5'-3" in span, of tile[3] 8"x10"x12"—6 hole ⅝-in. web laid up wet in 1:3 Portland cement mortar, fairly well grouted between blocks but with no mortar between skewbacks and surfaces of supporting I-beams, all covered above with a 4-in. 1:10 cinder fill. On the day of the test, the concrete and tile slabs were 29 days old.

The third 5-ft. 3-in. span was composed of a 4-in. slab of a mixture of gypsum and wood shavings[5], reinforced with the identical type of wire fabric mentioned above, covered with a 2-in. 1:10 cinder fill. Age on day of test was 14 days. Each supporting beam was protected by the material comprising the adjoining arch.

[illegible]

One-half the under surface of each of the first two arches was plastered with two coats while the gypsum slab was plastered throughout its entire length.

Estimated weight, dry, of cinder slab material was 98 lbs. per cu. ft. Estimated weight, dry, of gypsum slab material was 70 lbs. per cu. ft.

Purpose of the Test

The purpose of the test was to determine the effect of a continuous fire below the floor lasting 4 hrs., at an average temperature of 1700° F., a temperature generally conceded to be that of a burning building. The floor carried at the same time a distributed load of 150 lbs. per sq. ft. At the end of the 4 hrs. [illegible] red hot, was subjected to a 1⅛-in. stream of cold water through a hose at short range, under a 60-lb. pressure, for 5 min.; the upper side of the floor was then flooded with water at low pressure, and afterwards the stream was applied at full pressure to the under side for 5 min. longer. Deflections of beams and floor were measured continuously during the test. On the following day, when the floor was cool, the load was increased to 600 lbs. per sq. ft. and deflections noted.

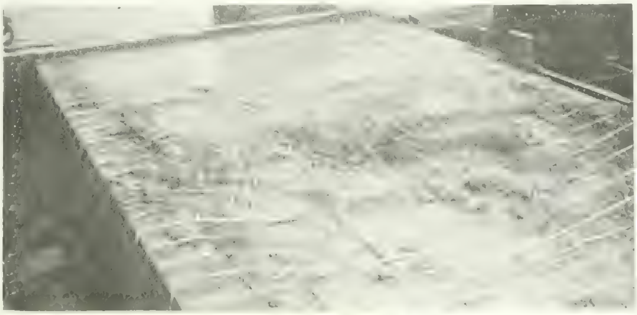
Load

Pig iron, stacked in segrated piles to eliminate arching, was the material used for load. During the fire the cinder concrete and terra cotta arches carried 150 lbs. per sq. ft. but the gypsum only 75 lbs. per sq. ft.

Temperature

The temperature of the fire was obtained by three electric pyrometer couples suspended through the floor from above and hanging about 8" below the ceiling. The fuel used was dry cord wood, one-half oak and one-half pine, the fre-

[illegible] LEVEL TO DEVELOP DRAFT



[illegible]

[illegible]

[2] Clinton Wire Cloth Co., Clinton, [illegible]

[3] National Fireproofing Co., [illegible]

[illegible] m Co., Chicago

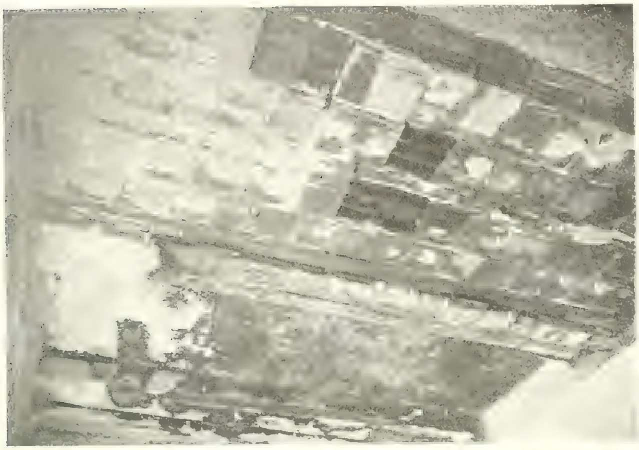


Fig. 4—After Fire and Water. In the Background is Shown the Gypsum Slab, the Terra Cotta Arch is Shown in the Foreground

quency of firing being determined by the temperature of the test chamber.

Effect of Fire and Water

Cinder Concrete—The combined effect of fire and water was to remove the plaster entirely from the slab, leaving the concrete itself in excellent condition. It was only in a region near its center, in order to strike which, the stream had to be elevated to nearly a vertical position, and consequently causing maximum punishment, that the surface was slightly pitted.

The protection to the deep supporting I-beam naturally suffered more severely. Possibly about 5% of the lower flange was exposed with rather deep seated cracks running a foot or so in both directions from the stripped portion. The remainder of the protection was deeply scored except for about 18 ins. at the front of the house where the water could not strike it. There it had retained its original sharp edges. The maximum deflection observed at the center of the slab at end of fire was ⅜".

Terra Cotta—About 80% of one beam protection, including many of the bottoms of the skew-backs, 10% of the other beam protection and the lower faces of six arch blocks, were knocked off during fire and water application.

At completion of load test the under surface of the arch was examined carefully. It was found that well over 75% of the lower faces were unsound, portions of which could be easily removed by hand. Practically the entire load was being carried by the central webs and upper faces of the blocks, many of the lower faces being entirely loose but keyed in by the remaining mortar joints.

This arch had attained a maximum deflection at the end of the fire of 1 3/16".

Gypsum—The protection to the reinforcement and to the supporting I-beam flanges in this bay was entirely removed where the water had full play. Toward the front of the house, where this condition did not obtain, the gypsum covering remained. The material above the wires was softened, deeply scored and presented a discolored smoky appearance. Four hours of fire produced a total deflection of only 1/16".

Conducted Heat

Thermo-couples were inserted in the concrete and gypsum arches, from the top, through the cinder fill and into the slab to within 1½" of the bottom. Readings were taken from time to time throughout the fire with the result that after four hours duration the maximum readings were as follows:

Cinder concrete	820°F
Gypsum	229 F

Effect of Cooling

Both the cinder and terra cotta arches recovered after cooling, whereas the gypsum settled somewhat.

Effect of Load

The cinder slabs withstood the load of 600 lbs. per sq. ft. with slightly over ½" deflection.

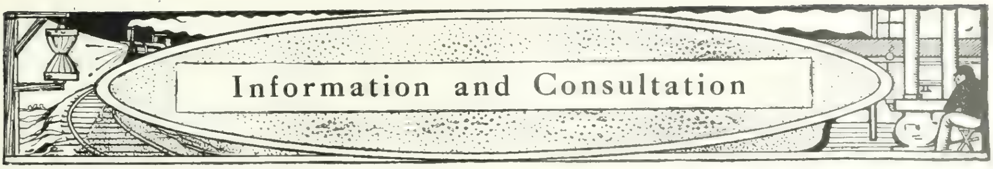
A deflection of less than ¾" was noted in loading the terra cotta arch to this amount. After release of load the camber of the arch could be plainly seen by sighting along the lower flanges.

When the load upon the gypsum slabs had been increased to 450 lbs. per sq. in., total deflection was ⅝". At 496 lbs. per sq. in. failure occurred and the slab was propped from beneath to prevent its total destruction.

The test was witnessed by the Aldermanic Building Code Committee and by many of the leading authorities on fireproofing and fire prevention. Automobiles were provided to convey the guests of the company from the Greenpoint ferry to the testing ground and refreshments were served.

Polk, Genung, Polk Co., Fort Branch, Ind., will erect a reinforced concrete warehouse and office building; plans are ready for the contractors. The structure will be 108′ long and 80′ wide, two stories high in front and one story at the rear. The firm manufactures a system of silo construction and the new building is made necessary by increased business.

Fig. [illegible]—The Cinder Concrete Slab After Fire and Water Test



Information and Consultation

We learn best by doing. This department is a place of exchange between those men who know from specialized experience and those men who want to know. The Discussions are specific and direct. In the following pages the topical heads show the many lines of activity in the concrete field which are covered. Questions and Discussions are cordially invited

265. Action of Magnesium Sulphate Solutions on Concrete Surfaces

"Can we use concrete to build tanks for some of the chemicals we have on hand all the time? For what chemicals could concrete storage vats be used?"

265. DISCUSSION BY DR. A. N. PHILLIPS*

With regard to using concrete surfaced tanks for holding saturated magnesia sulphate solution, we have had a tank built, which was surfaced with waterproofed cement mortar. The walls and floor of the tank were of brick. This was plastered with cement mortar about ½" thick mixed 1:2. The waterproofing was added to the material in the proportion of 1½ gallons per bag of cement.

This construction has not been an unqualified success, as recent examination of the surface of the concrete evidences by pitting that the action of the magnesium sulphate on the concrete has not been altogether prevented. At the same time, as the tank is nearly two years old, the destruction of the concrete surface has gone on with comparative slowness. We anticipate in the near future that the tank will need to be recoated.

EDITOR'S NOTE: The above discussion was referred to the manufacturers of the waterproofing material used, who in a recent letter, pointed out that the preparations used were for waterproofing.

For making a chemical resisting coating, more waterproofing material should have been used. Under the circumstances the resistance of concrete to a saturated solution of magnesium sulphate seems remarkable.

* * *

282. Concrete Tanks for Sauerkraut

"We are to build a concrete stave tank, to be used in curing sauerkraut. Can such tanks be made proof against the salt water and acids in the kraut?"

282. DISCUSSION BY N. F. M[illegible]

The Western Grocery Mills of Marshalltown were desirous of testing concrete tanks for the curing and storing of sauerkraut. The [illegible] Co. built for them a 5-ft. x 5-ft. concrete stave tank made from staves cast in the Playford[1] cement stave machine and proceeded as follows:

The tank was to be built on a factory floor made of wood. We first covered the spot on the floor with Neponset[2] paper. We then laid a bottom for the tank 4" thick, of good, clean sand and gravel, and cement, proportioned 1:3.

As soon as the bottom was troweled to a smooth surface we began at once to set up the staves, building them up to the height of 5'. We put 8 ⅝-in. round rod hoops around this tank and tightened them up. We were particular to put plenty of hoops on this tank for the reason that the tank in addition to the weight of the kraut was to withstand a weight of 1,200 lbs. on the top of the kraut.

After the staves were in place and the hoops tight, the tank was washed inside with brooms, applying neat cement and water, thus running all joints between staves full.

Applying Paraffin

Four days after this wash was applied, two oil heaters were placed in the tank and the tank covered over, until the sides of the tank were as hot as the stoves would make them. The stoves were then removed and the inside walls were treated to a coat of hot parafin. As soon as the tank had cooled, it was filled with kraut.

The kraut was allowed to remain in the tank, I think, about three weeks. When the tank was emptied, there were two or three spots about the size of an ordinary dinner plate. It was found that these spots had not been well covered with paraffin.

Before filling the tank a second time, these spots were given another coat of paraffin which entirely eliminated the discoloration. The Western Grocery Mills are well satisfied with their experiment and will build a new kraut house, using concrete tanks exclusively.

* * *

285. Sweating of Concrete Roofs

"We have had considerable difficulty with the condensation of steam on the underside of a concrete roof. The water caused by the condensation drips on to the machinery and is quite an annoyance. We are now building an addition and wish you would suggest some way of obviating this annoyance."

285. DISCUSSION BY HARRY FRANKLIN PORTER*

In summer keeping the heat out, and in winter keeping the heat in, in winter, too, avoiding condensation, are problems with which all manufacturers in single story structures, particularly of saw-tooth roof construction, have to contend.

In an Eastern plant manufacturing a high grade of electrical apparatus, this problem has never been one of moment, thanks to the forethought exercised by the management in construction. The roof slab was made double, with a layer of mineral wool between; the saw-tooth skylights double glazed; and a double system of gutters adopted, downspouting through the hollow steel columns, which provides not only for the roof run-off, but the interior condensation as well. A steam pipe runs under the gutters and in the winter the dry heat from this not only helps appreciably in getting rid of condensation but quickly melts any ice or snow collecting in the trough of the roof.

The fact that the roof and skylights are double greatly simplifies heating in winter, always a difficult problem in a saw-tooth area, and in summer contributes immensely to keeping the shop cool and comfortable.

In view of the results, this management feels abundantly justified for the greater investment involved in double roofing and double glazing. It is an investment which has paid generous returns in a healthier and more contented, and, therefore, more efficient working force, and a steadier and larger output per man; to say nothing of the decreased cost of heating in winter.

Concrete as an Insulating Material

In another instance, very good results were obtained by constructing the roof slab of the saw-tooth of porous aggregates—cinders and pumice—and making it somewhat thicker than if constructed of sand and stone concrete. The top was put in condition to receive the waterproofing material by slicking it with thin mortar.

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*Gen. Mgr. Chas. H. Phillips Chemical Co., [illegible]

[2]Standard Paint Co., N. Y. C.

[illegible]

[1][illegible]

[2]Bird and Son, E. Walpole, Mass.

*Chicago, Ill.

Concrete, particularly dense concrete, is a fairly good conductor of heat—not nearly so good as iron, of course, but much better than wood, mineral wool, or cork. Dense, thoroughly tamped concrete, experiments show, transmits heat twice as rapidly as porous, dry and untamped concrete, and three times as rapidly as cinder concrete. The superiority of the thicker cinder roof slab in the above instance is thus evident. Iron, on the other hand, transmits heat 70 to 100 times as rapidly as the densest stone concrete, whereas compressed cork, perhaps the best of the commercial articles for heat insulating purposes, is nearly 25 times as effective as stone concrete. Asbestos sponge is nearly as good as cork. Spruce and pine are about 50% less effective than either, but about 15 times as effective as dense concrete. Oak, however, is only half as effective as the softer woods, yet twice as effective as cinder concrete.

Air itself, while an excellent non-conductor of heat, must be quiescent to be effective as such; if circulating freely it is one of the best conductors, in fact is the principal medium of heat transference.

These facts are well to bear in mind not only in the case of roofs but side-walls as well. Some actually encourage loose construction as an aid to ventilation, but they fail to consider the effect upon the temperature, to regulate which at least cost and maximum efficiency requires practically absolute control over the points of entrance and issuance of the air supply.

* * *

288. Wrapping I-Beams

"What is the best way of wrapping I-beams with wire or wire mesh to prevent the concrete below the bottom flange from cracking and dropping off?"

288. Discussion by D. H. [illegible]*

Referring to the discussion under this item on p. 67 of the Aug. issue it is the writer's impression that Mr. Powell limits the scope of Prof. Woolson's article[1] somewhat.

There was more than one point in Prof. Woolson's article in the April, 1913, issue. The article, if read carefully, says that too light metal is liable to be destroyed by corrosion, too loose metal gets crowded out of position by the concrete, to say nothing of the fact that too small meshes block the flow of the concrete. The careful architect or contractor rules out materials having the first and last objections after a few trials, and in the effort to get a proper offset and *few enough strands* so as not to block the flow of the concrete, fails to get a proper reinforcement because of the shifting of the metal during the placing of the concrete.

The parts of a soffit that fire tests show are most in need of reinforcement are the parts beyond and below the edges of the flanges. These parts are most in need of reinforcement because in ordinary practice on average good work, examination shows that a very considerable percentage of the soffits that are supposed to be 2" thick will not measure more than ¾" thick under the centers of the soffits, and the common position of the reinforcement brings the metal in the air space instead of in the concrete. For this reason it is good practice for the reinforcement to be preferably a wire, held in definite position so that it provides reinforcement beyond and below the edges of the flanges and across the entire face of the beam. If the reinforcement is held in such a position and is continuous in form so as to give it rigidity and uniformity and has keying members at not more than 8" intervals, it will hold on even the thin centers.

*[illegible], N. Y. C.

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288. Discussion, Editorial

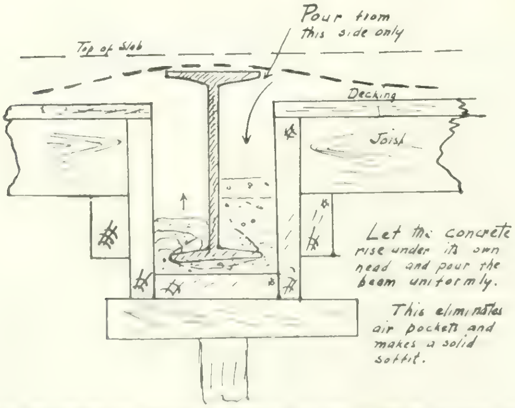
The discussions which have appeared under this question in the last six months are indicative of an earnest endeavor on the part of engineers and builders to get the best possible fireproofing work around I-beams. In brief, the question resolves itself into what is the best reinforcement for the fireproofing concrete, that is, for the concrete directly adjacent to the structural steel.

Under average field conditions in pouring the concrete around a structural steel beam or girder, there is a danger of having an air-pocket form under the bottom flange, and any method of using steel wire or mesh in a way which augments this danger is not to be recommended. In this connection, it might be pointed out that there is a method of procedure which can be followed which should to a great extent avoid this danger. In the experience of a member of the staff of Concrete-Cement Age, such a method was always required in field work and, as far as we know, produced satisfactory construction.

In pouring around floor beams the foreman had definite instructions to watch the quality of the concrete very carefully and to pour *from one side of the beam only* and personally to see that the concrete was so puddled on the side on which it was being poured that it rose up on the other side under its own pressure head. The accompanying sketch probably makes this a little bit clearer. In all cases this seems to have produced a solid soffit below the flange and to do away with any possible air-pocket.

It should also be added that it is good practice to pour a beam uniformly, that is, keep the concrete at a level as it is being poured. If pouring is started at one end of a beam and kept too long at one point, the fine material all runs out, leaving a poor concrete. The above is, of course, good practice in handling concrete in any confined space, such as walls, etc.

* * *


Pour from this side only
Top of Slab
Decking
Joist
Let the concrete rise under its own head and pour the beam uniformly.
This eliminates air pockets and makes a solid soffit.

[illegible] by Which Concrete [illegible] Poured Around I-Beams [illegible] Poured from One Side

290. Washing Concrete Material

"Is there any quick and easy way to wash gravel for concrete work?"

290. Editorial Discussion

In an article on the construction of the barrack at Corregidor Island in the present issue, the author states that the stone was freed from dust in the following way:

The bottoms of the wheel-barrows for handling the stone were perforated and the wheel-barrow loads on the way to the mixer were drenched by a man with a garden hose, the water and silt running down through the bottom of the wheel-barrow. This produced a fairly good washed material at a low cost.

* * *

307. Light House Whitewash

"What is a good formula for light-house whitewash finish?"

307. Editorial Note

In the May, 1913, issue we published under this heading the specifications of the Light House Bureau of the Dept. of

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[1] This refers to the discussion of this question on p. 180 of the April last issue, by Ira H. Woolson, Cons. Engr., Nat'l Bd. of Fire Underwriters, N. Y. C.

Commerce, for its light house whitewash. Since then, we have recently received from F. W. Vierling, West Orange, N. J., the following letter in which he describes with what success he followed the directions given under this item in the May number.

307. Discussion by F. W. Vierling*

I am well pleased with the results of the U. S. Government's formula for light house whitewash finish, for several reasons:

First. The first and most important of all, the cost of this is very low.

Second. The covering effect on a rough cement surface is remarkable, one coat giving a pure white finish. (Of course, it is not to be applied too thin.)

Third. The appearance of a pure white house, with red asbestos shingles, surrounded by a green lawn, is very pleasing.

By using this finish I saved $125 in the cost of this house over a similar one I built. The difference lies in the dash finish of white cement used on the former house which I could have entirely omitted had I known about the light house finish at the time. The side walls were trowelled perfectly smooth before applying dash coat finish.

Notes on Making the Whitewash

As a point of information to the layman who intends to use the Government's formula, caution should be used in the slaking of the lime. I went about the process by buying a large size whiskey or wine barrel for $1.00, knocked out the bottom of this and used the bottom as a cover, nailing a furring lath about 5 ft. long onto the cover so as to have a long handle to keep a distance from the barrel while holding the cover down. The lime, while slaking, is powerful enough to raise the cover off a barrel and we had to use force to keep the cover on.

Two men are required at this stage of the work, one to hold the cover and the other to pour the boiling water over the lime, as quickly as possible.

Add 3 pecks of salt dissolved in warm water, 9 lbs. of ground rice put in boiling water and boiled to a thin paste, 3 lbs. of clean glue dissolved in warm water; mix these well together in a large can and pour into the already slaked lime which will about fill the wine barrel. Let the mixture stand at least two days, stirring every day about five min. so that everything becomes well mixed.

Making Portable Furnace

I bought a large size ash can with handles on the sides and a cover. I placed two hollow tile blocks 8" x 12" x 12" about 18" on centers and put two iron bars across the tile and put the ash can over opening and built a wood fire under it. I stirred the mixture well while boiling and when ready for use strained it through mosquito wire from the can into a 12-qt. pail. I applied it as hot as possible with a white-wash brush.

The reason for not straining before was to get the full value of everything in the mixture at this boiling.

Surface Covered

Three such mixtures were required to cover this house, which is 23' wide by 56' long and 25' high. As the Government does not state how many sq. ft. of surface the formula will cover on a concrete wall it is hard for the layman to figure out how much he will need, and as this formula must stand several days before applying it can easily be seen that it will take some time to finish a job if the right amount is not made at once.

The Cost

The cost of all materials, excluding barrels, cans, pails, brush, etc. was $12.00
Labor for Applying 3 days at $2.50 .... 7.50

Total cost $19.50

I used the mason's scaffold, which was left standing for this purpose.

307. Discussion, Editorial

The above letter from Mr. Vierling seems so direct and to the point that to make the discussion complete we are re-publishing from the May issue the paragraph covering the receipt for the Light-house Whitewash. The formula follows:

Whitewash

The following recipe for whitewashing has been found by experience to answer on wood, brick, and stone[1], nearly as well as oil paint, and is much cheaper.

Recipe:—Slake ½ bu. of unslaked lime with boiling water, keeping it covered during the process. Strain it and add 1 peck of salt, dissolved in warm water; 3 lbs. of ground rice put in boiling water, and boiled to a thin paste; ½ lb. of powdered Spanish whiting, and 1 lb. clear glue, dissolved in warm water; mix these well together, and let the mixture stand for several days. Keep the wash thus prepared in a kettle or portable furnace, and when used put it on as hot as possible, with painter's or whitewash brushes.

* * *

325. Cinder Foundation in Sidewalk Construction

"We should be glad to hear from authoritative sources some expressions of opinion relative to comparative merits of concrete sidewalks with and without drainage foundation, using as a basis for comparison, a 4-in. thick slab of concrete laid on a cinder cushion 8" in thickness, or a 4-in. thick slab of concrete laid on a solid dirt bottom, without any cinders or other provision for drainage. Our own experience has been that the latter method is equally as good as the former, if not a shade better, other things being equal as to material and workmanship, but we should like some expressions from engineers and others in the trade as to which of the methods, if any, is either considered standard, or tending to become so.

"In this connection, we should like to know whether or not it is usual in the case of the cinder foundation being required, to demand that the cinders be passed through a ¼-in. screen, assuming that the cinders are a good grade of factory cinders, with the usual amount of fine material, but free from waste or rubbish. We have been in the habit of using the cinders as they come to us, but we are now asked to screen them through a ¼-in. screen, on the engineer's interpretation of the clause 'clean steam cinders' used in the specifications.

"Is the specification referred to not unusually strict, and arbitrary in general, and if required to be lived up to in its entirety, would it not make the cost of sidewalks laid in strict conformity with it a very expensive, not to say an almost prohibitive, job?

"We should be obliged for your opinion relative to the following terms from the sidewalk ordinance under which we are now working:

'clean steam cinders'
'clean, sharp, screened sand' (used in the concrete)
'covering and keeping moist for three days'

"We are trying to have a change made in the specifications which will allow of good work for less money than is entailed in laying the sidewalks strictly according to sample specification and your good advices, and those of correspondents will be appreciated."

325. Discussion by R. W. Bray*

I note in your Aug., 1913, issue some discussion regarding sub-bases, etc., for concrete sidewalks, and I would like to give my experience along this line as the use of a cinder sub-base is all the biggest humbug on earth. I don't use any sub-base in my work at all, simply because if I do the work will crack up. I not only learned this from bitter experience but also from Dame Nature, the *greatest engineer* and teacher, by observing an old flagstone about 1½" thick and 6' or 7' square out in the back yard used year in and year out through freezes and thaws with no other foundation than Mother Earth, and not a crack in it although the earth is low and mucky. I have lifted that stone with the assistance of a pick when the ground was frozen in zero weather and have never yet seen the ground frozen under it. My present practice is simply to lay my walk down on solid earth and it is one course walk at that, about 3 ins. or 3½ ins. thick, mixed 1:3 by volume, using cement and good clean unscreened bank sand. My work is thoroughly satisfactory.

One-course Walk Without a Sub-base

I believe this two-course work for either paving or sidewalk will be a thing of the past in a few years. I, myself, don't believe in veneering anything but I believe in and put down the true goods, the same at the bottom and the center as at the top. I always give my sidewalk work expansion joints, or in other words, I mold them in solid sheets of concrete and then with a special knife or more properly a spear,

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*[illegible] West Orange, N. J.

[1] [illegible]

*Heathsville, Va.

I go behind my men and with a straight edge and rule divide from top to bottom into sections about 4′ x 4′ or 4′ x 5′, and run my groover through these cut lines to edge them up. For first-class economical durable work I am ready to stake it with any contractor. This thing of digging a canal or reservoir under a sidewalk and filling in with cinders or porous concrete belongs to the class of impractical non-philosophical engineers, architects and laymen.

325. Discussion by G. S. Iredell*

In regard to specifications for laying sidewalks, I will state that in Austin we have several different kinds of soil on which to lay sidewalks, viz: clay gravel, clay, sandy loam, sand, limestone (from very soft adobe to medium hard rock), and lastly black vegetable soil. We have found that with the exception of the black soil, we can lay the sidewalk directly upon the natural foundation, providing it is properly packed, without unsatisfactory results.

Conditions Vary

Where we have black soil we find it necessary to excavate about 2 ins. deeper, and fill back with sand, as the black soil contracts and expands considerably with changes of moisture, and also has a tendency to crawl and to pull apart in dry weather, leaving large cracks in the soil, which are often communicated to the concrete. It sometimes happens, where the walk or curb is laid directly upon this character of soil that in a few months the concrete has raised in places several inches above the grade upon which it was first laid, or sunk below the grade, which distortion has, of course, cracked it badly. With a layer of sand or river gravel this trouble is to some extent overcome, but only a thickness of concrete heavy enough to withstand this great pressure, or sufficient reinforcing or a very thick layer of gravel or cinders will overcome the trouble entirely. We have not used the cinders here, as sand and gravel are about as cheap to use as the cinders.

The writer's opinion is that in this matter, the old saying "circumstances alter cases" should apply, and that the cinders or gravel foundation should only be used where the natural foundation is such as to make it necessary; certainly in the majority of sidewalks in this city, it would be foolish to go to the expense of a special foundation, involving additional excavation and hauling away of same, and the hauling in, grading and tamping of the cinders or gravel.

Qualities for Sand

In regard to sand, the term "clean, sharp, screened sand" is not altogether satisfactory in the writer's opinion. Sand should, of course, be free from all except a very small percentage of clay or loam, and sand, the grains of which have not been worn round by abrasion, is better than that which has, but the writer does not consider this of as great importance as the size of the grain. If the sand is too fine the voids between the grains are almost *nil*, and the cement does not distribute itself in mixing so as to properly coat each grain and bind it to its neighbors. If sand is too coarse,—and we often have such sand here—a larger percentage of cement is required in order to completely fill the voids, otherwise the concrete will be porous and of inferior tensile and compressive strength. It is important, therefore, to avoid these extremes, and our practice has been, if we get sand of the proper fineness, free from foreign matter, to pay no attention to its sharpness.

Sidewalks would be better seasoned if the rule to cover the same with ½″ of sand and keep moist by sprinkling for two or three days were adhered to. Our specifications call for covering the concrete until ready for traffic but not for keeping it moist. This retards its drying out and gives fairly good results.

325. Discussion by C. H. Vinal*

Relative to cinder foundation in sidewalk construction, I will say that it is almost necessary in our work to use something of that sort for drainage as our soil is clay and the frost works under the walk causing cracking. We are having very good success, however, in laying walks under our specifications, an abstract of which follows:

Sidewalk Specifications at Appleton, Wis.

Excavation: All excavation shall be made to a point 8″ below the grade of the finished walk and thoroughly compacted by wetting and rolling or tamping.

Filling: Should it become necessary to fill for foundation of walk, the material necessary to bring foundation to a point 8″ below the grade of the finished walk, the city of Appleton will furnish the material therefor at the site, the same to be placed and compacted by the contractor, as will be directed by the engineer.

Cinders or Gravel Filling: After the excavation or filling has been made and compacted to a point 8″ below the finished grade of the walk, there shall be placed thereon at least 4″ of cinders or gravel which must be acceptable to the engineer, the same shall be thoroughly compacted by sprinkling, rolling and tamping, so that the top surface will be exactly parallel with and 4″ below the grade of the finished walk.

Concrete: Upon the cinder or gravel foundation, prepared as hereinbefore specified, there shall be 3″ of concrete placed composed of the following proportions: One (1) part of imported or American brand of Portland cement; three (3) parts of clean, sharp sand; five (5) parts of crushed stone of the kind known as crusher-run which shall have passed through a screen with openings 1½″ in diameter, all to be mixed in a manner satisfactory to the city surveyor or engineer in charge. The mixed concrete shall be placed in the work, immediately after wetting and mixing of same, and thoroughly tamped or rammed in place.

Top or Wearing Surface: On top of the concrete prepared, as before described, there shall be placed a top or wearing surface composed of one (1) part approved Portland cement to one and one-half (1½) parts of coarse sharp sand of approved quality which shall be thoroughly mixed together while dry; when sufficient water shall be added to make what is known as a wet mixture, this shall be placed on top of the concrete before same has become thoroughly set, so that top or wearing surface will unite with the concrete. The finished or top surface, after trowelling to a smooth and even finish shall be stippled with a stippling brush, drawn crosswise of the walk.

Cement: Samples of the cement to be used must be presented at the city engineer's office at least 10 days prior to the time it is desired to commence work, (about 5 lbs. will be required to make test). In submitting the samples the packages must bear the name, brand or stamp of the manufacturer and the sample should be taken promiscuously from several sacks or barrels of stock.

(The specifications include also general requirements for the cement.—Editors.)

Sand: All sand used must be free from dust, loam and dirt and shall range in size from ⅛″ to the finest and in such proportions that the voids, as determined by saturation, shall not exceed 33% of the entire volume, it shall weigh not less than 95 lbs. per cu. ft., and the particles must be sharp. No wind drifted sand will be allowed.

Crushed Stone: All crushed stone used in making the concrete shall be of the best quality of limestone or other hard stone, trap-rock or granite, shall be clean, free from dirt and broken to the size hereinbefore specified.

Sand Joints: The walk shall be divided by sand joints into areas of about 25 sq. ft., said joints must extend the full depth of the concrete and shall be cut through the top or wearing surface directly over the joints below.

Expansion: Expansion joints from ½″ to 1″ in width shall be left along any curbing where walks abut. Said joint to be filled with natural asphalt to within ½″ of the top. The balance to be filled with sand.

325. Discussion by R. D. Goodrich*

Specifications in use and provided by ordinance in this city require a 6 in. cinder cushion for a concrete sidewalk of 5″ in total thickness. While some of the contractors in this city think that no cinder cushion is necessary, we personally are of the opinion that it is far better to use a cinder cushion.

The first reason is that a cinder cushion provides good drainage under a walk which decreases the liability of unequal settlement for one thing. More important than this, however, it prevents the accumulation and saturation of the soil with water and therefore prevents the formation of frost beneath the sidewalk. We believe that the prevention of the danger of the action of frost on the sidewalk is of the greatest importance, as the unequal expansion due to the freezing of varying amounts of water under a sidewalk without cinder cushions tends to raise the sidewalk unequally in different places.

Cinders Prevent Vegetable Growth

Another advantage in the use of cinders is that as they are exhausted material, they provide no food for the growth of trees and the roots of shade trees do not enter under a sidewalk having a deep cinder cushion to the same extent that they would were there no cinders used.

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*Asst. City Engr., Austin, Tex.

*City Engr., Appleton, Wis.

*City Engr., Cheyenne, Wyo.

In this city where the trees are planted very close to the sidewalk, we find this of an immense advantage, as our experience with concrete sidewalks is that they retain their grades far better and far longer than flagstones laid on a thin gravel foundation. Specifications in use in this city provide that the fine material in cinders may be required to be screened out and discarded so that coarse porous material will be used in foundations. Specifications also contain the usual clause requiring the use of clean, sharp sand which must be screened through a sieve having ¼-in. meshes. They also require a sidewalk to be protected and kept moist for sometime after it has been laid.

325. Discussion by J. Q. Wickham*

In view of the experience of 14 yrs. in municipal work in Iowa, and having in that time come in contact with nearly all manner of construction of concrete side walks, I am of the opinion that for this section of the country the most satisfactory walk can be made of a good clean coarse gravel run mixed 1:3 or 1:3½ with a good standard cement. In case of hand mixing the cement and gravel should be mixed to a uniform color before adding the water, and the water shall be of sufficient amount to make a mixture of a fairly wet nature so the same can be troweled the same as is customary in top coat work.

One-course Walk the Better

It will be seen from this that I believe in single coat work. I do not advise the use of a top coat in any event for the reason that practically our only failures of walks have been due to the unequal expansion of the top coat walks in the extreme hot months of summer and not from the heaving of the walk by frost in winter.

No Foundation Required

Neither do I believe in requiring a cinder foundation of any kind for this part of the country as it is not nearly so substantial as the walk proper, and often gives way, aside from giving a place for the water to settle, bringing ruin to the walk itself. I certainly would much rather have clay or the average upland dirt for the foundation than any cinders I have ever seen in this section of the country. I therefore am frank in saying that it has been my experience that a good dirt foundation, where good firm earth can be had without extra hauling to the site, is much better than a cinder foundation, of any kind or depth, other things being equal as to material and workmanship.

Specification Requirements

I do not believe that "clean steam cinders" [illegible] that they must be passed through a ¼-in. screen, and unless there was an "intent clause" in the specifications for the contractor to hide behind I do not believe that he could rightly hold that the cinders must be screened unless he specifically said so in his specifications, and could hardly make it hold even though he had intended it in but had forgotten to insert it in the specifications. The specifications to which reference is made are really good ones but need someone with a little judgment to carry them out. I never yet have seen the set of specifications written but that if they were put in the hands of some unreasonable, unpractical or unprincipled person, they would bankrupt any contractor if the job was big enough.

"Clean steam cinders" without any other restrictions, would most certainly not indicate to me that they be passed through a ¼-in. screen, (or "over the screen" if anything).

"Clean, sharp, screened sand," would indicate to me that it must be screened free of pebbles over a ¼-in. screen, and have not to exceed 5% of clay or other deleterious material, such as sticks, straws, chips, etc.

"Covering and keeping moist for three days" would indicate to me that the contractor would be required to cover the finished work with paper, sacks, carpet, sand or anything that would not discolor or damage it in any way, also that he would be required to keep the concrete moist, not wet, by throwing water on it at intervals. On hot days he should be required to put it on as often as it dried off, and on cloudy or dull days perhaps once per day.

I therefore would advise single coat walk, a 1:3 or 1:3½ mix, troweled down smooth but given a brush finish, ¾-in. expansion joints every 50′ on level ground and every 30′ on all grades above 3% or 4%, and the walk to be cut in sections of from 4′ to 6′, said cuts preferably being made with steel divider plates, and the walk to be constructed on a foundation of natural earth where possible.

325. Discussion by L. D. Smoot*

Relative to the use of cinders for drainage foundation under cement walks, I wish to state that in this section of the country our sub-soil is entirely sand, and no drainage foundation is necessary. The use of cinders as a drainage foundation therefore is entirely unnecessary.

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333. Permanence of Concrete Silos

"In talking with a [illegible] this vicinity who is considering the construction of several silos, he has advanced the objection to concrete construction on the grounds that there is a chemical reaction between the concrete and ensilage which spoils the latter for a distance from the wall.

"He also states that he has heard that the acid in the ensilage has a deteriorating action on the concrete which will eventually cause the concrete to crumble. Can you give me any information in regard to this?"

333. Discussion by [illegible]

We have found the concrete silo has given universal satisfaction provided it was rightly constructed, of good material, well reinforced, and on a good foundation. The walls, however, as sometimes built, are porous and the silage is apt to dry out near the walls of the silo unless the inside of the silo is given a coat of some material which will fill the pores of the concrete.

Coal Tar Coatings

Field men of this division have assisted in the construction of a large number of concrete silos in the South and West. These silos were given an inside coat of raw coal tar, thinned with gasoline and applied with a brush. This coat, which should be renewed as it wears off, serves the purpose of making the walls airtight; it also protects the concrete from the action of the silage juice.

We have not had a single complaint that the silage did not keep well in these concrete silos. The severity of the action of the silage juice on the concrete depends, I believe, to a large extent on the material used for aggregate. I have seen concrete silos where the silage juice seemed to affect the concrete very little, even though the walls had not been treated with coal tar. Again, I have seen a silo in which broken limestone was used for aggregate affected quite severely by the action of the silage juice, especially around the doors, which did not fit tightly, and where the concrete was not protected by the coal tar.

Our experience has been that raw coal tar, thinned with gasoline, is a very good preparation for coating the inside of concrete silos to keep the acid from affecting the concrete; and if the silage is well packed and the corn of the right degree of maturity there will be very little, if any, spoiled silage near the walls. We also use coal tar for coating the inside of stave silos.

333. Discussion by [illegible]

In regard to the permanence of concrete silos, we have two concrete silos in Buffalo Creek Farm. The first one was erected in the summer of 1908 and filled with silage the following fall and has been filled with silage each year since, or five times. This silo is 18′ in diameter and 47′ high. In the upper part we have a wooden tank 14′ in diameter and 6′ deep resting on steel I-beams. This tank holds about 185 bbls. of water.

The silo is monolithic construction, built with steel forms which were about 6′ high. These forms were filled with concrete and allowed to harden one or two days and then raised and filled again. The thickness of the wall is [illegible] at the top. The silage has kept in perfect condition right up to the wall and there has been no waste. I have been watching the different silos, stave, and board, and find that the silage in the concrete silos seems to keep better than in the stave silos, as far as keeping right up to the wall is concerned.

We [illegible]

[illegible]

[illegible]

*Supt. [illegible]

walls to preserve the concrete. In this silo it has never seemed to need anything. It might be well to watch a silo and in case any effects of the acid on the concrete became apparent it would be well to brush it down with steel brushes and give it a wash of pure cement, put on with a whitewash brush, once a year or once in two years.

The following year, 1909, we built another silo which has been filled four times. We find that the contractor on this work was much more saving in his cement and the acid has affected this silo from ⅛" to perhaps ¼" in the wall. By taking a chisel or sharp instrument it is possible to dig into this wall to that depth and in some places small stones can be picked out. This silo has been filled with silage almost continuously; we use it for a summer silo so we have only had it empty once within the four years. It is evident that a good grade of sand and gravel should be used; also a good brand of Portland cement and good rich mixture. It is well to fill the forms with this mixture thoroughly moistened; it should be put in rather wet and well tamped or spaded so the walls will be smooth. The work should be first class in every respect and with a pure cement wash the cement silo should last indefinitely.

* * *

337. Silicate of Soda Paint

"Some time ago the following formula was given to us to make a paint for concrete work, claiming that it could be washed and scrubbed:

Silicate of Soda—N grade....1 gal.
Oxide of zinc ground in water..1 lb.
Flour marble enough to make the whole to the consistency of paint.

We have followed the directions and it gives a beautiful white, but it comes off and peels. We then reduced the silicate to about 20° Beaume and it does not entirely come off. When you rub it with the finger, once dried, some powder comes off.

Will you please tell me the cause of that trouble and the remedy?

If you know of any work on silicate of soda paints for concrete, will you please advise me the name of the work, that of the firm who sells it, and if possible, the price?"

337. Discussion by W. H. Kellog Jr.*

It appears to us without making actual experiments with this formula that a good deal of the difficulty would be overcome by adding soap solution to the formula, perhaps somewhat along the following line:

1 lb. Armours "Flint Brand" Shredded Soap.
1 gal. of 20° Beaume Silicate.
1 lb. of zinc oxide and flour marble.

The addition of the soap solution should prevent peeling and prevent powder coming off from the paint after same has hardened.

Another remedy for this formula or rather complete change of formula may be arrived at as follows:

Casein combined with ammonia water and this combination combined with glycerine to which could be added zinc, marble flour and cut down to the desired consistency with soap solution as described above should be applicable but the working out of such a formula would require considerable experimenting.

337. Discussion by R. A. Plumb*

In our extensive experience specializing in waterproofing and dampproofing products, we have quite naturally given a great deal of time to determining the exact possibilities of sodium silicate as a practical constituent of such a product. Sodium silicate is readily soluble, and this inherent property is still retained after the product has been applied to any surface and hardened. There are methods of fixing the silicate, by mixing with the sodium silicate a salt that will precipitate a metallic silicate, but in this way usually the binding and hard characteristics of the original silicate are destroyed.

Judging from our experience and general observations, we do not believe that it will be possible to make successful application using sodium silicate as a binder where there is any requirement for washing, or exposure that will bring dampness in contact with the paint.

We also do not believe that any method of fixing the silicate in an insoluble form will be found and still retain the binding and hard drying qualities of the silicate so as to give a satisfactory paint coating.

In fact we abandoned any further attempt to utilize sodium silicate, even as an interior product, some months ago, and we are certain that for exterior exposure, or interior where washing is an essential property, products which are not soluble will have to be used, and these must be repellent and resistive to the action of water.

* * *

338. Preparing and Letting Bridge Contracts

"I would greatly appreciate some information as to the manner in which a contract for public highway bridge construction should be prepared, and the letting handled."

338. Discussion by Wilbur J. Watson†

In regard to county bridge work, it has become a too widespread practice in letting contracts for county bridges to allow each bidder to submit his own designs, together with his bid, specifying only the loading, the factor of safety, and sometimes the type of bridge. It will readily be seen that even in the case of plans for small steel bridges, these requirements leave considerable latitude in design and hence there is no true competition on the part of the contractors. Very seldom is anything said in the specifications about the matters of impact or distribution of concentrated loads (a very important item). The factor of safety requirement does not definitely fix the unit stress to be employed. It is such methods as this of letting public work which are responsible for the "skinned" designs of short-lived steel bridges so universally in evidence.

When the same practice is extended to plans for reinforced concrete bridges, other factors remain indeterminate. The writer has seen many such invitations to bidders which did not even specify the mixture of concrete to be used and, besides, the "factor of safety" of reinforced concrete is not nearly so definite a quantity as it is for structural steel.

Bids for county work should preferably be based upon complete plans, prepared by a competent engineer, on file and should allow no misunderstanding as to what is required. In case contractors are allowed to submit alternate plans with bids, such alternate plans should never be accepted unless checked over by a competent engineer. The loose method of calling for plans has but one thing to commend itself: it allows the authorities greater latitude in placing the contract.

Many states have engineers in the employ of the state, whose duty it is to design small highway bridges for the counties when called upon so to do. The principal difficulty with this arrangement seems to be that the state designer is unable to give sufficient study to individual problems. The writer has seen many examples of free state bridge design in many states, and most of the work observed has been subject to this criticism. A recent example was a reinforced concrete culvert, designed by the bridge engineers of a state highway department, built with flaring wings down stream and straight wings up stream. The designer probably never saw the site either before or after the bridge was built, or else the stream reversed the direction of its flow during the Easter floods, which turned so many bridges upside down and wrong end to.

It would help some if no bridge engineer were allowed to design a bridge for a site he had never seen, nor for a bridge the construction of which he could not supervise. Such a requirement would cut off some of the writer's practice, a sacrifice which he would cheerfully make "for the good of the cause."

The writer most firmly believes that the best results in all bridge construction are to be obtained by the employment of a bridge specialist, a man who makes this work his life study, requiring that the bridge specialist shall make a careful study of each bridge site, however small, and prepare complete designs and specifications for its construction.

An expert bridge engineer can cover in a few days' time in the field, all the ordinary construction carried out by a county in a year, and the plans can be completed in the office as needed. The field work can be taken care of, in most cases, by the county engineer, in consultation with the bridge expert.

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*Sec. The Consolidated Cos., N. Y. C.

*The Trus Con Laboratories, Detroit

†Cons. Engr., Cleveland

The cost of employing such an expert is small. One reason why a bridge expert is not more often employed is that the county surveyor or engineer often considers himself thoroughly competent to do such designing. Often they are very competent men, but it needs no argument to prove that a man who spends twenty years doing one kind of engineering work is more expert therein than another man who spends twenty years doing fifty kinds of engineering work, as the county or city engineer is called upon to do.

The writer has found many cases where city or county engineers were afraid to tell their superiors that they needed expert help, or where they had been refused the help on the basis that they (the city or county engineer) were paid to do such work themselves.

The writer has digressed somewhat from his text and will return to it long enough to say that the chief argument for competition plans for bridges is that it opens up an opportunity for "graft." The writer does not wish to be understood as saying that competition in detais, such as types of reinforcing, etc., should not be allowed, subject to checking of the engineer in charge. Often a design can be much bettered thereby. Neither does he wish to be understood as being in favor of not allowing competitive designs to be submitted when the original design is made by incompetent engineers or else made without sufficient study, in which cases much benefit may accrue to the county by asking for alternate designs, but such designs, if allowed, should always be checked by a bridge expert and should preferably be designed under a standard specification.

339. The Use of Lampblack in Concrete

"Does the use of a small amount of lampblack to darken concrete, weaken it at all?"

339. Discussion by S. B. Newberry*

Relative to the use of lampblack in top surface of sidewalks, I saw this practiced at Dayton, Ohio, as much as fifteen years ago. I can see no reason to conclude that lamp black, in the amount of 5% or 10% of weight of cement, has any weakening effect. The German text-books recommend lampblack as an addition to cement, among other pigments found to be permanent and non-injurious. Simple experiments would, of course, determine this question. I cannot imagine any injury from the use of a moderate percentage of lampblack which would perceptibly affect the durability of sidewalks. I think it unlikely that any other substance could be found which would give anything like the darkening effect of lampblack in small percentage.

340. Fastening Timber Plates to Concrete Walls

"What is the best and most efficient method of fastening a 2-in. x 8-in. timber plate to the top of a concrete wall? What methods are in most common use for either monolithic wall or block wall?

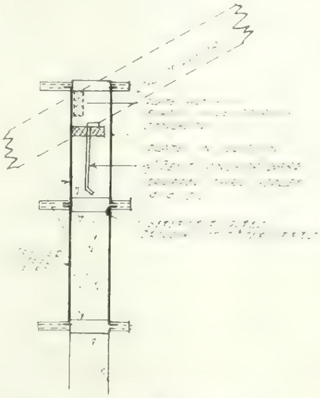
340. Discussion by C. R. Knapp*

The best and most efficient method and the one most generally used in fastening the timber plate to the top of a concrete wall is to place ½-in bolts in the concrete 4′ to 6′ apart. The bolts should go down into the concrete at least 12″, and extend above wall 3″ or 4″, depending on thickness of plate. The plate is then let in over the bolts and the nuts screwed down, holding the plate close and fast to the wall.

On small work the upright reinforcing rods are sometimes used if they extend above the wall far enough. The plate is let in over these and rods bent over and fastened to plate. In the case of concrete blocks the bolts should extend down at least two courses and be held in place by a piece of flat iron under the block.

340. Discussion by M. D. Morrill†

We find in our building of poured concrete houses that the most satisfactory method for fastening the wood plate to the wall, is to suspend the plate in the forms on edge, and pour up to the proper height, almost up to the under edge of this plate. This plate is bored with ¾-in. holes 3′ o. c. and as soon as the concrete work is poured, this plate is unfastened and dropped into place, tamped down to a level at the proper height in the concrete. Reinforcing rods 18″ or so long, of ½-in. or ⅝-in. steel, with the top bent at a short angle, are droppd through these holes and forced down into the wet mixture.



Sketch Showing the Method [illegible] Roof Plate is Anchored [illegible] Wall

We have found this a very economical and rapid way of setting the plate level, so that when the forms are removed, the wall is ready to receive the rafters.

The accompanying sketch shows this method. We have found it necessary to have plate slightly less in width than the thickness of the wall, so that it could be dropped and forced down easily between the forms, allowing the excess to work up at the edge in leveling the plate.

340. Editorial Discussion

The method as described by Mr. Morrill in the above discussion is very similar to methods used several years ago by one of the staff of Concrete-Cement Age. We were, at that time, building a concrete church, the walls of which were of poured concrete to the very top. Wooden forms were used, built in panels 3′ high and in convenient lengths, usually about 12′. The wall was 8″ thick and the concrete was being elevated by hand in a specially designed bucket hoist arrangement.

The problem of fastening the rafter plates required quite a little thought for this was a good many years ago and it was the first problem of its kind that had come to our attention. We wanted to handle it as cheaply and effectively as possible. Our solution, while similar to Mr. Morrill's, was in a way simpler, because our forms came only to the top of the wall, were accurately leveled and the concrete "struck off" at the top of the forms. We handled the work as follows:

When the concrete was finished to the top of the wall for any section, a 2″ x 8″ plank, in which ½-in. holes about 24″ on centers and staggered across the width of the plank, had been bored, was laid on top of the concrete. Through the holes scrap pieces of ½-in. reinforcing steel, on the average about 24″ long, were punched down into the concrete until only about 2″ of the rod stuck up above the face of the plank. Within a day or so, or when the forms were removed, a man went along the top of the wall with a 2-lb. sledge and bent the rods over snugly into the 2-in. x 8-in. plank.

This seems to be a very economical and effective way of anchoring a roof plate and worked out very satisfactorily.

340. Discussion by Rolf R. Newman*

The method I have used in fastening a timber plate to the top of a concrete wall (either monolithic or block) has been to use ⅝-in. bolts about 14″ long, spaced every 4 ft. The bolts are bedded in the center of the wall and so placed as to run vertically up through the plate (when placed) and project enough to receive washer and nut.

340. Discussion by A. M[illegible]

Holding the top wood plate on the top of a concrete wall on which the rafters rest is a simple matter if the [illegible]

[illegible]

[illegible]

*Albany, N. Y.

†[illegible]

[illegible]

[illegible]

builder concretes ¾-in. bolts 12″ long, allowing about 4″ to project above the top of wall. The bolts should be placed about 4 ft. centers. It is always best about a concrete job to make everything as near everlasting as possible, so the bolts should be galvanized or Sherrardized. Sherrardized iron will last longer than the galvanized.

Wood blocks or grounds concreted in the wall for nailing the plate to may be used, but I have found bolts to be the best for fastening wood timbers to a concrete wall.

* * *

342. Concrete Doors for Mausoleums

"I believe it would be possible to use a reinforced concrete door to good effect in mausoleum construction. What advice can you give me?"

342. Discussion by Benjamin A. Howes*

I have used small pre-cast concrete doors on various jobs with entire satisfaction. In the case of a concrete mausoleum I think a properly reinforced door, cast with proper rabbets, would be entirely successful, although it should have heavy bronze hinges. I think a steel or iron door would give great trouble from rusting. For my own practice I would prefer bronze or reinforced concrete, with all the steel reinforcement thoroughly protected from rusting by the concrete.

In building reinforced concrete septic tanks for sewage disposal, and in building water supply systems, where a hydraulic ram or electric pump was installed in connection with water tank, I have used small doors of pre-cast reinforced concrete ranging in size from about 18″ x 18″ to 2′ x 3′. I used these doors instead of iron work to avoid rusting.

For hinges we used in the concrete jamb massive wrought iron eyes, made of 1-in. round rods. The doors were cast from 2½″ to 3½″ thick, with beveled edges to swing tight in the concrete jambs, which were cast with proper rabbets. The doors were reinforced by a cross mesh of ⅜-in. steel rods, 4″ apart, made by bending standard 16-ft. to 18-ft. rods without cutting, into a gridiron shape. The door part of the hinge was made by bending 1-in. rods approximately the size of the periphery of the door but slightly smaller. This bar was so laid as to be about 6 ins. from 3 edges of the door, with upset ends projecting at the proper hinge points to engage the eyes set in the jamb.

The hinges were set slightly out of the plumb so that the door would naturally tend to swing closed, and eyes were cast in the jamb, and in the door, for fastening with bar or padlock if desired.

The iron work showing was painted one coat of red lead, two coats of asphaltum, and the hinges greased with thick axle grease.

The results have been entirely satisfactory, although being rough and ready work in the nature of design to meet the local requirements.

* * *

343. Removing Rust Stains from Concrete.

"What is the best way to remove rust stains from concrete surfaces?"

343. Discussion by Fred W. Scholz*

I have found out from investigations that oxalic acid will not attack the concrete, but will probably not take the rust stains out either. Perhaps it might be well to try a solution of hydrochloric acid and stannous chloride ($HCl + SnCl_2$). The solution should be quickly applied and will give good results, provided the concrete has not too much carbonate of lime ($CaCo_3$) in its composition. If quickly applied and then removed, it will not attack the concrete, and will also remove the rust stains.

* * *

344. Low Cost Concrete Mausoleum

"Will you please give me some information on how to build a concrete mausoleum? Where could I obtain a plan of one that will cost from $300 to $400?"

344. Discussion by Benjamin A. Howes*

In regard to the construction of a concrete mausoleum to cost from $300 to $400, I am afraid that the appropriation would allow no more than the building of a rough and ready reinforced concrete vault, of the smallest practicable dimensions. My suggestion would be to make it on the type of a receiving vault in the side of a bank, so there would be a minimum of exposed concrete which would require special treating for the sake of appearance.

To discuss the matter further we should know more details in regard to the problem, specially how many caskets have to be provided for and if it can be built in the side of a bank as noted above.

Provision must be taken also against dampness. By provision against dampness, I do not mean waterproofing but precautions against condensation which arises at certain seasons of the year.

345. Chimney Construction in Monolithic Cottages

"I am planning to build several poured concrete houses and want to know the best way of building concrete chimneys. What advice can you give me?"

345. Discussion by Wm. Walter Smith‡

The advantages of one-piece concrete chimneys are almost too apparent to require mention. On account of their solidity, and the consequent absence of joints through which sparks often pass, concrete chimneys provide perfect protection against fires and afford a sense of security which goes far toward making home a place of protection and repose. The same is true of concrete fireplaces, mantles and hearth-stones. Such improvements are not only safe, but are also economical since the first cost is the only expense; there are no repairs.

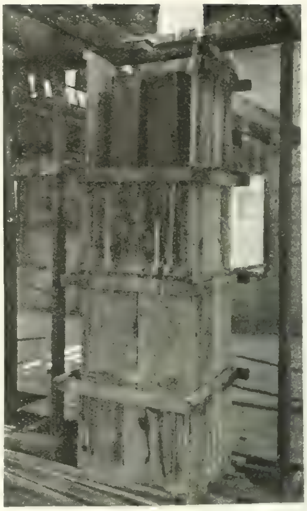
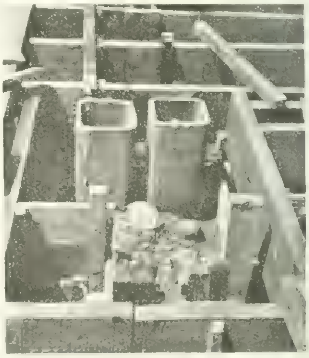


Fig. 1—Detailed View of Concrete Chimney Construction

In this work two 8-in. clay flue linings are used as inside forms. When concreting the chimney, care must be taken to keep the concrete from falling down into the flue openings. On the work shown a concrete board was fitted over one of the stringers as shown. Any little board with a lug placed on it to keep it over the tile would do all right

The construction of a concrete chimney is a simple matter. A firm footing and a good foundation are essentials; therefore, if necessary, reinforce the foundation a couple of inches from the under side of the concrete with steel rods laid in both directions. The forms for the chimney are merely an outer and an inner box with 6-in. to 8-in. space between, in which the concrete is poured. Since it is considered better practice to have a separate flue for each fireplace, stove or furnace, the chim-



[illegible] Construction With [illegible] View

This shows the terra cotta flue lining in [illegible] concrete being poured around them ney is usually divided into two or more distinct passages for smoke.

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*[illegible] N. Y. C.

*N. Y. C.

†Engr. and Contr., N. Y. C.

‡[illegible] Kansas City, Mo.

There are patented forms on the market for molding monolithic chimneys; but, owing to variations in size and shape, most builders prefer to make their own forms. The outer form consists of two vertical wooden panels of a length equal to the height of the story of the house. The third, the middle side of the form and the fourth (if the chimney is not part of the house or partition wall), is made in sections of 1′ to 2′ in length to minimize labor in placing the concrete and to aid in the correct locating of the reinforcing. The inner form is in full or sectional units and is collapsible and removable. For the inner form, most builders prefer to use ordinary terra cotta flue lining, concrete tile, stove pipe, etc., and leave the same permanently in position. Two to four inches of concrete should be placed between the individual flues as insulation.

Cinders for Aggregate

For chimneys, a 1:2½:5 concrete is preferable to a richer mix, as it does not expand so greatly when heated. Clinker cinders is the best aggregate at the points of highest temperature. Gravel concrete ranks second. In general, the best concrete for the purpose is made from the stone which is least affected by fire. Through the attic and above roof-lines a 1:2:4 concrete gives the chimney greater strength and usually makes unnecessary the use of guy wires and rods. At the roof-level, flashings of copper sheets should be embedded in the concrete to prevent rain-water from running down around the chimney.

Reinforcing

For residence chimneys, vertical reinforcing rods about ⅜″ in diameter are generally used. These steel rods are placed 1″ from the outside of the chimney and are located at the corners and opposite each concrete web between the individual flues. They are given ordinary column lacing with wire at intervals of 6″ to 12″. The rods are well lapped and wired at joints, and joints are broken so as to avoid sections of weakness. If for reasons, such as roof-symmetry, the chimney is not vertical, it then in a sense becomes a beam and must be reinforced accordingly. The possibilities of this phase of construction make the concrete chimney decidedly popular.

Artistic Effects

The decorative features of concrete chimneys are merely limited by the conception and skill of the builder. Varied relief work is possible. Decidedly pretty effects are obtained by ornamenting the chimney with tile inlays in appropriate designs. Of chief interest, however, is the fact that one-piece concrete chimneys are fireproof. In burnable houses, they reduce the fire-risk to the minimum. They are the finishing touch for fireproof all-concrete residences.

345. Discussion [illegible]*

Pouring a flue or chimney integrally with the rest of a building is a saving over brick and often advantages are gained. But to guard against the possibility of a crack paralleling the chimney, care should be taken to reinforce against this.

Wrapping Flue Lining

I have concreted against ordinary stove pipe, but do not advise this plan. The better way if stove pipe is used is to wrap 3 or 4 layers of asbestos paper around the pipe. Better still is to use ordinary burnt clay flue lining which should be wrapped with asbestos paper. The paper allows for expansion and also insulates the heat from the concrete.

Where stove pipe would be used the pipe will no doubt rust and pieces of the pipe and asbestos paper may clog the chimney.

There should be at least 5″ of concrete around the flue and at intervals of every 3′ there should be ½-in. rods looped around the flue from bottom to top and at the junction of floors at least double the reinforcing.

When the chimney is in a residence I have found it most practicable to design the chimney breast and fireplace opening so as to build in a tile or brick mantle.

345. Discussion by G. E. Huggins*

Relative to chimney construction, we have built chimneys from hollow concrete tile, using flue lining (clay) in center, but have erected none of the monolithic type. We figure the cost of tile construction to be about half the cost of a brick chimney.

It occurs to us that the cost of erection of forms, for poured chimney walls, would be rather expensive, and likewise think that without the use of flue linings, the absorption (by solid walls) of moisture would have a tendency to retard the action of the gases and smoke.

Within the past year, we recall reading in Concrete-Cement Age of someone "yelling for help" to correct the discoloration on monolithic chimney construction. The discoloration, was said to have been due to creosote forming and leaking through the walls. I mention this incident simply to clinch the argument that if certain gases can get out, moisture certainly can go in, and the combination is very bad for concrete chimneys.

345. Editorial Discussion

Under Question 301, entitled "Wrapping Flue Linings with Paper," on p. 181 of the April, 1913, issue, a detail of chimney construction is discussed. Under Question 308, page 241, of the May issue, the matter of creosote staining concrete chimneys is discussed. Each of these items should be of interest in the discussion of the above question.

346. Silos for Storing Grain

"I am asked to build [illegible] stave silos to be used for storing grain.

"They are to be erected in a rectangular group and are to contain 4,000 bus. each. They are to be erected close to a railroad track on regular Iowa soil.

"Now what I want to know is how deep should the foundation go to insure against settling. The silos are to be either 12′ or 14′ in diameter. How much should the foundations extend over the outside line?

"About 6 ft. below the surface of the ground is a stratum of gravel. Is there any special likelihood of trouble on account of gravel so near?"

346. Discussion by J. B. Davidson*

It is our opinion that such a silo will store grain satisfactorily when provision is made for caring for the pressure of the grain. It is customary to assume that the lateral pressure of wheat in a bin varies with depth, increasing from zero at the top until a depth of about 40 ft. is attained. At this depth it is about 2½ lbs. per sq. in.

The friction of the wheat on the walls is great and provision should be made for caring for the stresses so produced. Steel plate grain bins have failed by crumpling at the bottom. If good solid gravel should be obtained for the foundation we do not think that any trouble will develope by simply extending the foundation well below the frost line. It is good practice to reinforce the floor of the bin, thus making it carry the greater part of the total weight of the grain stored. We assume in this connection that the floor will rest upon solid ground.

* * *

347. Cleaning a Marble Monument

"I have a contract to clean a soldier's monument about 6 ft. square at base and about 30 ft. high. This has been up 40 years and never been cleaned before and is in bad condition. There is present a dark discoloration and a fine moss which seems to have penetrated the marble some little depth. What method can I use to clean this off?"

347. Editorial Discussion

The object sought is not to bring into solution the marble of the statue but rather the seeking of a solvent for the organic matter which has evidently eaten its way into the pores.

We would be inclined to believe that the best method of taking off verdigris would be to make a hot solution of 1 part of hydrochloric acid to 4 parts of water, to which should be added a little potassium chlorate; the action in this particular case being the oxidation of the organic matter, as mixtures will not vaporize with any of the bases excepting ammonia; its oxidizing and chlorinating effect, however, is exceedingly strong.

We should think that good results could be obtained by this solution, if kept hot.

We should think that good results could be obtained by this solution, if solution of acetic acid might be tried [illegible]

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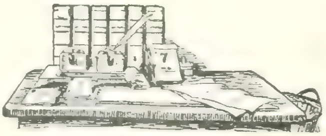
*[illegible]

*[illegible] Homes Co., [illegible]

*[illegible]



Correspondence

An urgent invitation to the cement and concrete industry to make itself felt at the Panama-Pacific Exposition; a description of attractive garden ornaments; an authoritative opinion of the importance of coarse sand in pavement work; notes on the construction of large and handsome stables and two important recognitions of concrete stone—these things go to make the Correspondence this month of wide interest.

A Cement Show at the Panama-Pacific International Exposition

I desire through the columns of your paper to call the attention of the cement trade, in all its ramifications, to the fact that the time has come for all intending exhibitors at the Panama-Pacific Exposition to make their applications for space without delay.

The Panama Canal, which someone has aptly characterized as the "greatest liberty ever taken with Nature," is a triumph of American enterprise and American engineering skill. The nation is justly proud of this achievement and proposes to celebrate it by holding an International Exposition in San Francisco in 1915. I wish to lay especial emphasis on the word *International*. Because of its location, the Exposition is often thought of as California's Exposition. While the majority wish it success and hope to take it in, a great many people do not seem to realize that practically everyone who occupies a position of responsibility in American professional and industrial life owes some direct thought and attention to this Exposition *now*.

In a sense California is the host. In a larger sense, however, the nation is the host. The nation, through the President and the Congress of the U. S., has issued the call and has invited world-wide participation.

The importance of the event we are celebrating is such as to lift one's thought above the merely sordid question, "What is there in it for me?" The Exposition makes a direct appeal to every American citizen—first to his patriotism and next to his pride in the industry which he represents. It offers to every beneficiary of the industrial prosperity which has marked the last decade, an opportunity to contribute to the most effective educational work that could be undertaken. A well conducted International Exposition is a great University in which the officials are the regents, the exhibits are the faculty and the public at large is the student body. If this Exposition is a success, everybody will be benefited. It is our individual duty to unite in a national effort to insure this success, regardless of whether we may or may not foresee any tangible individual benefits to result from our participation.

The suggestion has been made that because manufacturers of cement and its products operate in comparatively small territories and are not having much trouble in disposing of their output, they have little incentive for the trouble and expense of making an exhibit; that it will be difficult to interest the cement and cement products trade unless direct, tangible local benefits can be shown. I do not believe the trade will take this narrow view of the matter—a view unquestionably detrimental to its best interests.

Electricity and Cement, the Great Factors of Modern Civilization

The two great factors of modern civilization are electricity and cement. The more spectacular of these—electricity—has been featured at several expositions. In 1904, the year of the last International Exposition, held at St. Louis, the cement and concrete industry was a "youngster." Today the industry has attained its majority. Every great movement, every important industry requires a certain amount of broadcast sowing to educate the public mind. This has been neglected in the case of the cement industry. While it has made great strides in the last ten years and has, perhaps, outstripped most other industries in the matter of growth, still, it has never been properly introduced to the public and the public has little conception of its full importance.

A Cement Show of national scope, properly conducted on a scale commensurate with the importance of the industry, would furnish a most effective and a most economical advertising medium from which the industry would derive incalculable benefits, both direct and indirect. It would draw conventions of engineers, contractors, builders, dealers, etc., all of which would stimulate the educational value of and interest in the show.

Hundreds of thousands of people from all over the world, representing a picked and necessarily well-to-do class, will visit this Exposition. They will be awakened to the importance of cement in modern engineering work and to the diversity of uses to which it may advantageously be put in every day life; to its durability, its resistance to fire and, withal, its artistic possibilities. The exhibit would undoubtedly exert a favorable influence on the public mind in connection with legislation regarding dust, containers, etc. An artistic display, associated with the name of any cement manufacturing plant or any manufacturer of cement products, would certainly attract the attention of visitors from the section supplied by such exhibitors.

The Palace of Mines and Metallurgy is comparatively small and the demand for space is going to be huge. The net available area for the entire industry in all its branches, foreign and domestic, is 170,000 sq. ft. The most I could set aside for the cement industry would be 25,000 sq. ft. and that would be giving it preferential treatment. This space, properly utilized, would be adequate for a representative, collective exhibit of the industry.

A part of the exhibit might be in the form of a small building designed to represent in itself many phases of concrete building construction, methods of form and cribbing construction, types of reinforcement, methods of finishing and coloring walls, floors, ceilings, etc.

Most of the work could be shown in various stages of construction, for instance: columns with one or more makes or designs of forms adhering to the concrete would show how forms are made and fastened and how they look when in place. By omitting the concrete from a section the reinforcement could be shown.

This plan could be extended to every important part of the building. Methods of construction, moulding, plastering and surface finishing, artistic and ornamental work of every kind, all may be shown in various stages, all set into the exact positions assumed in actual work. The materials, tools and plant would be shown in conjunction with the various exhibits. Adjoining the Palace of Mines is the Esplanade, where place could be found for an Italian garden to illustrate the adaptibility of cement to landscape gardening. Climatic conditions in San Francisco and the rapid plant growth of this section make this possible even at this late date.

To conclude: The educational and advertising possibilities of a properly arranged Cement Show at this Exposition are unlimited. It will bring the building public, on the one hand, and the architect, the engineer, the contractor, the builder, on the other hand, into close touch with every detail of the concrete industry; it will do this under conditions and in an atmosphere which cannot fail to impress them favorably. It will undoubtedly stimulate the demand for concrete over a competitive material and will educate the public to new or little appreciated uses for concrete. The cement trade, in all its ramifications, can well afford to spend a hundred thousand dollars or more, if necessary, on this and reap a hundred fold in growth and expansion.

The Panama-Pacific International Exposition is providing, *without cost* to accepted exhibitors, the housing and necessary space for their exhibits, ample fire and police protection, general janitor service, splendid transportation facilities, one way freight charge and free return of exhibits to point of origin, general lighting of the building, cheap electric current for special lighting or power service. Exhibitors are assured of an immense audience drawn from the four quarters of the globe and they have the opportunity of securing valuable awards by the International Jury.

Charles E. Van Barneveld
Chief Dept. Mines and Metallurgy
Panama-Pacific Exposition
San Francisco

Japanese Garden Lanterns of Concrete

The accompanying illustrations show reproductions in concrete of Japanese stone lanterns. One of the firm while traveling in Japan a few years ago procured a number of examples of Japanese stone lanterns, and our concrete department has been very successful in reproducing these, using varying aggregates. The forms were produced by first coating the lantern sections with glue, filling in previously with clay any nooks and where necessary resorting to cores. Plaster forms were then molded, these in turn were well treated with soap and the sections poured, using aggregates of crushed stone and cement in various proportions calculated to produce stone-like surfaces when properly treated. These casts were removed from the forms just as soon as they would hold together, and the cement skin washed off, leaving the stone aggregate showing conspicuously. We found after a little experimenting that we could make most interesting reproductions, in fact, some of them are so faithful to the original forms and appear so much like carved stone that even an expert would have difficulty in distinguishing them from the original stone. In some cases we found it desirable to resort to some chiseling; very little of this, however, was done.

E. F. Coe

President and Treasurer
Elm City Nursery Co.,
New Haven, Conn.

* * *

The Importance of Coarse Sand in Concrete Road Work

I have been much interested in looking over the articles in the Sept., 1913, issue of your paper describing practical methods of building concrete roads. There is one point, however, which my experience in concrete surfacing has shown to be more important than any other, which is scarcely emphasized at all throughout the discussion. I refer to the selection of the fine aggregate. With all the failures there have been in concrete roads, it is surprising that so little attention has been paid to the fact that very large numbers of them are due simply to the selection of a sand which is not coarse enough to produce a dense, hard wearing surface.

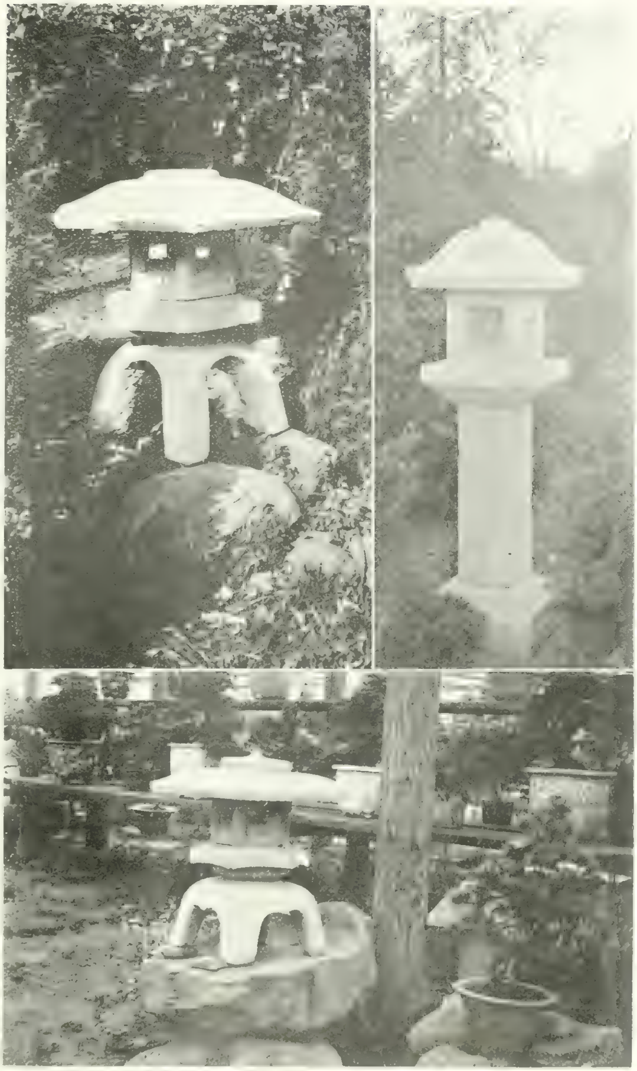
Referring to the analysis of the sand used in the government work at Chevy Chase, which is given on p. 103 of the issue referred to, it will be seen that it is of exceptionally good quality from the standpoint I have mentioned. It contains only 26.2% passing a No. 50 mesh sieve and only [illegible] passing a No. 100 sieve. It is not sufficient simply to specify the limit to the percentage passing a No. 100 sieve, but sand should also be required to have a very large percentage of particles coarser than, say, a No. 40 mesh.

Furthermore, the selection of the sand should not be left, as is customarily the case, to the "snap" judgment of a foreman or even an experienced engineer. It should always be subjected to a laboratory test to determine its strength in mortar as compared with standard sand mortar in the same proportions, mixed with the same consistency. The strength of the mortar made with the sand in question should equal the strength of the standard sand mortar.

In referring to this very important matter, I do not wish for a moment to under-rate the importance of first-class workmanship, but the fact is that, while with mediocre workmanship a first-class surface often can be obtained with the right kind of sand, unless the materials are satisfactory, the best of workmanship will not produce durable concrete.

Sanford E. Thompson

Consulting Engineer,
Newton Highlands, Mass.

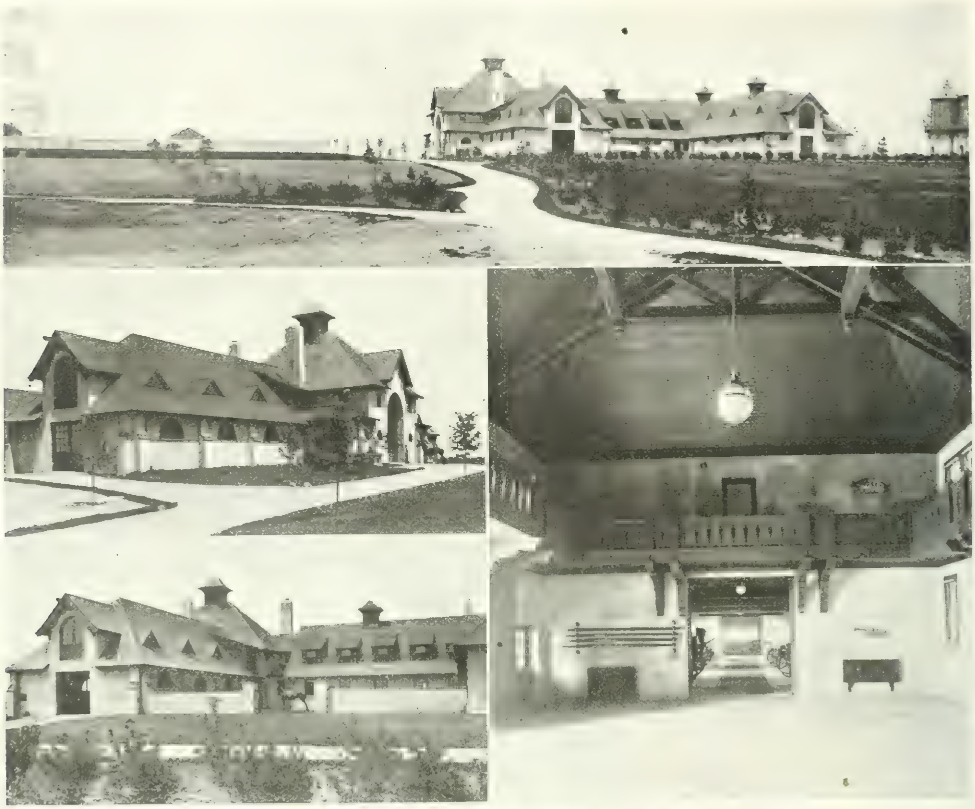


Japanese Garden Lanterns Made of Concrete

Stables and Riding Ring for Thoroughbred Horses

The stables designed for Harry S. Bowen, Round Hill, Conn., are very extensive and I believe about as complete in every way as it is possible to have them. They were planned for thoroughbred horses only.

All the exterior stucco was applied on hollow terra cotta block. The entire inside walls throughout were cemented absolutely smooth with Portland cement and sand, producing a beautiful granolithic surface. All the floors throughout were of concrete granolithic finish, those in the runways and the head house being divided into 6-in. squares with heavy jointing to act as a foothold for the horses. In the carriage rooms



Stables with Stucco Exterior and a Reinforced Concrete Wall at Round Hill, Conn.

[illegible] detail of the concrete work, showing the wall of the riding ring at the left, below are two exterior views showing the stucco work and at the right [illegible] view

and harness rooms, etc., the floor was divided into flags about 2′ square with a narrow joint. All intersections of floors and side walls and all angles and jambs of windows were neatly rounded or coved so that there were no right angle corners.

Dircetly in front of the stable there was constructed a riding ring slightly larger than the floor surface of the Madison Square Garden, New York City; the idea being to exercise and show the horses in this ring preparatory to the annual horse show at the Garden in New York. The entire fence enclosure of this riding ring was of reinforced concrete finished with a concrete cap. The fence was approximately 4′ 6″ high, stiffened at corners, and about every 8 ft. with chamfered reinforced concrete posts 6″ x 6″; the actual wall itself being about 2½ in. thick of reinforced concrete, and in casting the sections, small hexagonal blocks of wood were placed in a row along the upper part, which were taken out after the concrete had set, and left openings, giving a pleasing decorative effect. The fence was reinforced with galvanized iron Clinton[1] wire. After the forms were removed the fence was given a wash of cement and sand. The exterior stucco work on the stables was three coat work, the first being a heavy scratch coat of Portland cement and sand; the second coat of Portland cement and sand was left from the rough float, and the finishing coat was a mixture of very gritty white Cow Bay sand mixed with Blanc Portland cement, in a proportion of about one and one. It was dashed on leaving a beautiful buff white tapestry surface. It was the most successful piece of stucco work that ever has been done for this office and after almost three years seems to show no discolorations of any kind whatever.

[illegible]
Arch., N. Y. C.

Uses of cement are of interest not only to the architect, the engineer, the contractor and the builder, but they are of deep importance to every home owner who wants better construction at less cost, to every tenant who wants the most for his rent money in house comfort and protection against fire, to every citizen who has the city's welfare at heart in sanitary buildings, more beautiful architecture and safer construction. Out of concrete will be built the sculptured monuments of the future

An Estimate of Good Concrete Stone

As to our experience with manufactured stone, we desire to say, frankly, that in our opinion, the product known as Cut Cast Stone, which we are using in several projects, with great success, is a most admirable substitute under certain conditions for more expensive materials, and has, in our opinion, also a great future, not that we should prefer it to the actual stone itself, that it is made to resemble, but we would not hesitate, in certain circumstances to suggest to our clients, its liberal use in their place. We are now erecting three large buildings for the Police Department,[1] and the exteriors of these buildings are entirely faced with Cut Cast Stone, the results of which have been very successful, and excited much interest by all who have seen these buildings. These buildings when first laid up in this material, were somewhat cold in appearance, but after a few months' weathering, have attained a warm and creamy appearance which is most pleasing to the eye, and seems impossible to be distinguished from a buff limestone wall.

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[1] [illegible]

[1] New York City

We have found that this material takes the carver's tools exceedingly well, and weathers quickly into its proper color.

We have also used this material in conjunction with brick in a large brick house with excellent results,[2] the stone having the virtue of soon toning down with the brick, and avoiding the harsh and sharp contrasts which marble and new limestone frequently give with some face brickwork.

In addition to the use of this cut cast stone product, we are about to erect a building entirely built of a cut cast granite which, for an imitation of the real stone, is most amazing.

The greatest difficulty we have had in the use of this product is, in the maintaining of the integrity of the arisis, for, in the transportation and handling from a great distance of large quantities of this artificial stone, frequently laid out in delicate and intricate forms, these are apt to be damaged and broken, and while they are repaired either before or after setting, the damage is always apparent, and, in our opinion, never can be quite eradicated.

This we feel is the greatest peril in its future use, although careful and organized handling will correct much of this danger.

HOPPIN & KOEN

Archs., N. Y. C.

Preferable to Natural Product

My experience with this artificial cut cast stone prior to the use in the Geneva City Hall structure has been confined to small quantities in different buildings in the last few years.

It has proven so satisfactory as to warrant its more extensive use. In this I find a product of concrete which departs from the appearance of imitation and has, in my estimation, some qualities which recommend its use in preference to the natural product.

It lends itself well to architectural detail and it is easy to carry out tones and color harmony.

While my first thought in the use of manufactured stone was economy, (which I believe in costs is not of sufficient amount to be much considered) I now feel that it is entitled to an equal showing with the natural products which it represents.

[illegible]

Arch., Geneva, N. Y.

Following the preservation of the Egyptian mummies in the British museum, London, by the addition of a concrete roof, it is but a natural thing that concrete should be used to give pleasure to the live children of Boston by converting the Old Common pond into a wading pool for the little people of Boston.

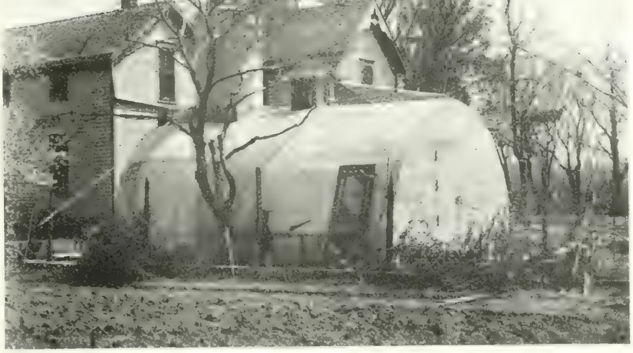

FIG. 1—CONCRETE CYCLONE CELLAR AT THE HUBBARD FARM

Concrete on a Kansas Farm

BY CHARLES DILLON*

The how-to-do it value of this article is purely general. It tells how a farmer added much to the value of his property by numerous odd uses of concrete. It should suggest to contractors who are in communities where they can do just such work how business may be expected from the farmer

When Tom Hubbard bought his farm in Kansas, in 1889, it carried a large mortgage, thousands of small stones, one medium-sized spring surrounded with mud, and no improvements. There were 200 acres of it, some of it farmed to death by a man who imagined that Kansas land would give corn crop after corn crop indefinitely.

The Hubbard place now is called Roseland, and is near Kimball, which is in Neosho county, Kansas. Roseland is the concrete example. I don't believe that many farms in this country give better proof of how concrete makes for comfort. Tom Hubbard, of Roseland, finds his chief joy in fashioning things of concrete. Not freak ideas, but the important, useful, convenient and health-preserving comforts that can be made with this material when you know how.

To erect a water storage tank of large capacity, Mr. Hubbard says, involves too much expense for the ordinary farmer. Therefore when a monolithic silo was built at Roseland, a year ago, it carried a water tank at the top. Some men use iron for this kind of tank, but Mr. Hubbard made his of concrete, using the same forms that were used in building the silo. This elevated storage tank serves a double purpose, obviously. It supplies sufficient pressure to operate every faucet in the house, bath room, kitchen and butler's pantry. It will, indeed, throw a stream almost over the house and so gives a fairly trustworthy fire protection from its 40-ft. elevation.

This tank holds 262 bbls. of water. It is filled rapidly from a little spring around which Hubbard blasted out a cavern 50′ deep in the rock and this has filled and overflowed into a great reservoir which has a concrete bottom and sides. Pipes lead from it to the gasoline pumping plant, which fills several tanks like the one described.

Other concrete comforts at Roseland are: Concrete sills or curbs for every

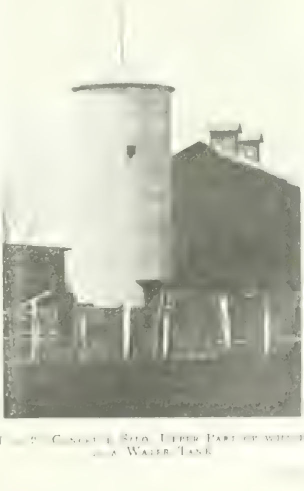

FIG. 2—CONCRETE SILO, UPPER PART OF WHICH IS A WATER TANK

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[2] [illegible] e on Long Island elsewhere in this issue. [illegible]

*Until recently of the faculty of Kansas Agricultural College, Manhattan, Kans.

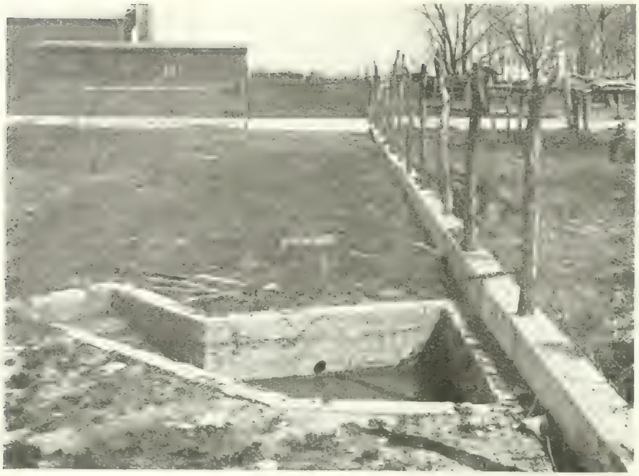

Fig. 3—Fences with Concrete Curbs and a Concrete Bath for Hogs in Pasture

fence near the home, about 2,000′ of it; a concrete fence 1′ thick, 3′ 6″ high and 300′ long around a hog lot; concrete retaining walls around the spring, preventing surface water from flowing into feed lots; concrete drinking troughs for all animals; concrete floors in all barns and feed lots—corrugated to prevent slipping; concrete drinking troughs for poultry and concrete bathing pools for hogs. There are concrete walks everywhere about the farm headquarters and about 4,000 ft. of concrete walk to the railway station. The porches, and the walks and the platforms around the hired men's homes are of concrete. Cattle do not stand in mud when they drink. They stand on concrete platforms. In the winter they can stand in a concrete-floored feeding pen, roofed and closed on all sides except the one that gets the sun of an afternoon. The concrete sewer system, nearly 2,000 ft. of it, insures health and cleanliness. There are concrete cisterns to catch drainage from the big barns, four in number; an ice house of concrete and a cellar of the same material. The garden is irrigated from an elevated concrete tank. The farm is, indeed, an excellent example of just what may be done to improve country living in the use of material which is cheap, most of which is obtainable on or near your own farm.

The comforts at Roseland are not the comforts of a rich man. They are within the means of the ordinarily prosperous farmer or suburbanite. He didn't put in his concrete in one lot, either. Instead of buying another 50 acres when his bank account was larger than usual he spent a part for some improvement of what he already owned. Concrete presented the finest opportunity, in his opinion, and he used it.

Probably the most attractive feature of Mr. Hubbard's story lies in the fact that the comforts he has provided with concrete are within the reach of men of moderate means. In completing the curb for his fence, for instance, Mr. Hubbard had a ditch dug 6 in. deep and about 8 in. wide. The posts, which are of cedar, were first put into the ground in holes 8′ apart and 2′ deep. Into the trench between the posts the men put some coarse, broken limestone, and into this broken stone poured a thin cement mortar, or "soup," as the men call it. When this mortar set, the broken stones were a solid mass. Above the ground form boards were set 6″ high and filled with small stone and cement mortar made of sand, chats (from the zinc mines not far away) and cement, thus giving a concrete fence foundation about 1 ft. high from the bottom in the trench to the top above the ground. It is believed that the cedar posts will last for many years in this setting, as posts in concrete do not rot. Some of Mr. Hubbard's fence curb is more elaborate than that described. Mr. Hubbard's concrete curb for the fence cost from $4 to $7 a cu. yd. This included the trench.

A corrugated, concrete floor in one of his barnyards, 80′ by 80′, cost from $4 to $6 a cu. yd.; but here also Mr. Hubbard used more concrete than almost anyone else would think necessary. With a foundation of cinders or chats, this barnyard floor could be laid exactly as sidewalks are laid, and for about the same price. Mr. Hubbard's concrete sidewalks around the fields, a luxury if ever there was one, cost about $1 a sq. yd. These concrete walks are 3′ 6″ wide and 6″ thick. They are laid on chats.

The tank on the top of the silo cost about $10 a cu. yd. It was built exactly as the silo was built, with the same reinforcing. The floor of this tank contains about 7 yds. of concrete, and the sides about 4½ yds., which makes the total cost for the tank about $100. This includes the labor and material for reinforcing.

The cyclone cellar cost Mr. Hubbard very nearly $250, but here again he admits that more money was spent than was needed. The cellar is 12′ x 16′ x 22′.

The concrete floors around the watering troughs are 6″ thick. They cost about $1 a sq. yd., and were laid exactly as sidewalk is laid.

A Definite Proportion for Cement

In a recent issue of the *Iowa Engineer*, Stanley Macomber, city engr. of Centralia, Wn., states that a number of engineers in southwestern Washington are using clauses similar to the following in connection with their specifications for concrete work:

Every cu. yd. of concrete 1:3:6 mixture shall contain at least 4 sacks of cement.

Every cu. yd. of concrete 1:3:5 mixture shall contain at least 4½ sacks of cement.

Every cu. yd. of concrete 1:1:1 mixture shall contain at least 12 sacks of cement.

Every 2 cu. ft. of top mixture 1:2 shall contain at least 1 sack of cement.

For cement over this amount nothing will be paid the contractor.

For every sack of cement under the above amount the regular price shall be deducted from the total sum due to the contractor.

The contractor to figure on the above amounts rather than on the direct mixture.

Arrangements must be made with the city engineer for the proper inspection of the amount of cement used.

During the day the inspector tries to keep the mix as near correct as possible and at night the empty sacks are counted and a material slip filled out, signed by the inspector and the contractor. A copy is given the contractor and a copy put on file in the office. When it comes to a final settlement these slips are taken as receipts for the amount of cement used. The amount of cement hauled onto a job is also kept in this manner as a check.

Standardization of Concrete Work

In a recent paper presented to the Institution of Engineers of the River de la Plate, South America, H. L. Rogers, after describing the methods of cement testing in the Argentine Republic and giving full details as to the various sands and building materials used there, sums up the situation in that counrty so far as building construction is concerned in the following words:

"Concrete work in Argentina suffers from want of standardization. Selection and combination of available materials is unscientific and wasteful. Concrete does not enjoy the reputation that it deserves simply because it is not so well understood as a building material as is brickwork, steelwork, or timbering. Much of the concrete work done in this country is very inferior and might have been better done, in many cases, in plain brick. Yet concrete is far stronger, should be much more impermeable, and should be cheaper than any other constructional method."

Reinforced Concrete Apple Cannery

Six miles south of the battlefield of Gettysburg on the line of the Western Maryland R. R., surrounded by some of the finest fruit country in the world, is the station of Orrtanna, where the Orrtanna Canning Co. is building an up-to-date and efficient plant. The distance from usual building supplies and from skilled labor made the erection of a canning plant with a capacity of 1,000 bus. of apples per day an unusually difficult problem in view of the fact that the owners wished to use a fireproof construction and to eliminate insurance and maintenance cost.

The large farm purchased by the company could supply quantities of rough stone suitable for crushing, and this, coupled with the fact that the plant of the Tidewater Portland Cement Co. is located at no great distance, making cement available at the minimum price, pointed to reinforced concrete as the logical solution of the problem.

The factory building proper is 255′ long x 32′ wide with an ell 100′ x 20′, the central portion being two stories in height and the rest of the building having walls about 10 ft. high. There are two basements, one 60′ x 32′, the other 20′ x 40′. The different parts of the plant are separated by firewalls of concrete, which will be provided with automatic fire-doors.

To erect the double walls, which consist of one 3-in. and one 4-in. wall with a 2½-in. continuous air space and reinforced throughout with wire and steel rods, two hollow wall machines[1] were used, securing a building that is damp proof and of uniform temperature without the use of any forms. It is interesting to note that even the cider tank in the basement and the setting for 150-h. p. Coatesville boiler were built with these hollow wall machines. Four hundred barrels of cement were used for the walls of the building and as the stone was crushed by the owners of the building, no account was kept of the quantity used, but judging from the amount of cement, in the neighborhood of 350 cu. yds. will be required.

Construction Details

All corners, including window jambs, are rounded and the entire building inside and out will be finished with a coat of cement plaster. The only wood used is in the door and window frames and the frame of the roof, the roof itself being of slate, requiring two car loads, or 325 squares.

The euipment of the factory will be of the latest type and will embody a number of original ideas invented by the owners. The apples will be received at the northern end of the plant and the two-story portion contains the machinery for preparing and canning. The cores and peelings are carried by a conveyor into the ell, where they will be taken care of by two hydraulic presses. The cider, being later evaporated, is marketed as boiled cider. The remainder of the building provides ample storage for supplies and stock. The owners believe that they have secured the most satisfactory construction for this type of building yet devised, as the entire buildings were constructed by cheap, local labor under the supervision of the owners.

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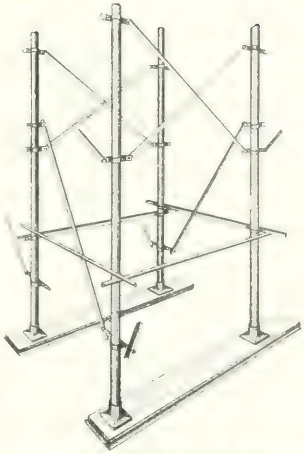
[1] Van Guilder Hollow Wall Co., Rochester N. Y.

The Use of Pipe Falsework

A recent issue of *Beton u. Eisen* publishes a description of the renovation of the dome of a church in Baden, where steel pipe falsework was used by the Dyckerhoff & Widmann Construction Co. The dome was about 120 ft. above floor level. The details of the scaffolding used are shown in the accompanying sketch and the specifications required that it support a load of 1,200 kg. sq. m. (240 lbs. per sq. ft.). It consisted of sections, each made up of 10-ft. to 20-ft. steel pipes 3″ in diameter with walls 0.12″ thick. At the joints steel pipes of slightly smaller diameter, about 20 ins. long were used. These were fitted inside the first steel pipes and had at the center a 5-in. wide steel band of the same diameter as the outer pipes. Consequently the larger diameter pipes were separated from each other by the steel band, and at the same time had a strong bond at the joints, since there were both inside and outside steel pipes.



Sketch Showing Arrangement of Steel Pipe Falsework as Used in Germany

Angle irons in horizontal and inclined position were used as diagonal and transverse supports. The bases are composed of iron shoes resting on wooden or concrete beds. The upper working platform was of the usual wooden type resting on I-beams, bolted to the iron falsework.

The Harbor City Cement Co., Everett, Wn., has been successful in landing a substantial number of sewer tile contracts this season. The contracts in the city of Everett and Snohomish county will total about 26 miles of tile, ranging from 4-in. to 24-in. In all this work the company has won out against the stiff competition of large clay products concerns. The company's business this season will run about $30,000. The plant is fitted with a double Thomas machine which is kept running night and day. C. M. Robbins is manager of the company nad H. W. Shaw is president.

[illegible] Hollow Wall [illegible]

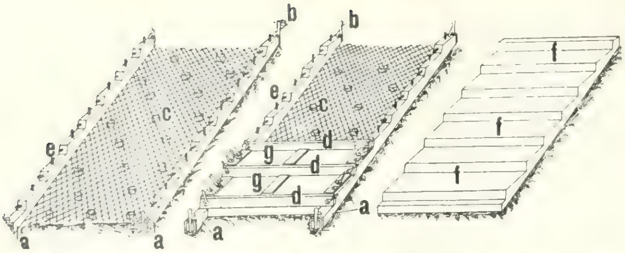


Fig. 1—Details Showing Procedure in Building Concrete Slabs for Shore Protection

A New System of Concrete Coast Protection

A new design of reinforced concrete coast protection has been developed by a Dutch engineer named De Muralt. The coast where the protection is to be used is first leveled off at a certain angle and firmly tamped down. Then the reinforced concrete slabs 8′ long, 6′ wide and 4″-5″ thick are made. For this purpose stair-like molding beams are used, as seen in *a a* (Fig. 1). These are laid exactly parallel to each other at intervals of 6 ft., their lower ends being at the same level. The pins *b*, driven into the ground above, hold the beams in place. Piles *c* are then driven into the ground at intervals of about 1 ft., their ends being left to project about ½ in. out of the ground. Over these piles expanded metal mesh is laid and nailed down on the piles *c*. After a riser board *d* has been bolted to the bolt *e* at the lowest step, the concrete is placed at the lowest step. Then this step is covered by means of a board *g*, and thus each step is finished until the entire section looks as seen at the right of Fig. 1.

For banks exposed to sea water and to storms, the concrete is used mixed 3:1:5:8, using cement, trass, sand and gravel respectively. The spaces between the concrete slabs are filled out with T-shaped reinforced concrete beams, shown in Fig. 2. The templates *a* are inverted and laid upon the steps as shown in Fig. 2. About 3 ins. or 4 ins. of the edges of the concrete slabs protrude on either side. The ground between the slabs is excavated down to a certain depth, usually 2 ft., the projecting ends of the slabs well oiled, and the trench and space between the slabs filled with concrete. Into the grooves *h* found on the reverse sides of beams *a*, boards *i* are placed, which smooth the concrete surface beneath and are left there until the concrete has set.

The same procedure is followed with the transverse frames to produce a complete frame, which holds the slabs in place without developing a rigid connection with them, thus giving enough movement to the slabs to prevent cracking. It is for this reason that the edges of the slabs are oiled before being covered with concrete. To strengthen the frames, reinforcement shown in *j* (Fig. 3) are used, also of expanded metal. The outside frame *k*, most exposed to the sea waves, is built extra strong.

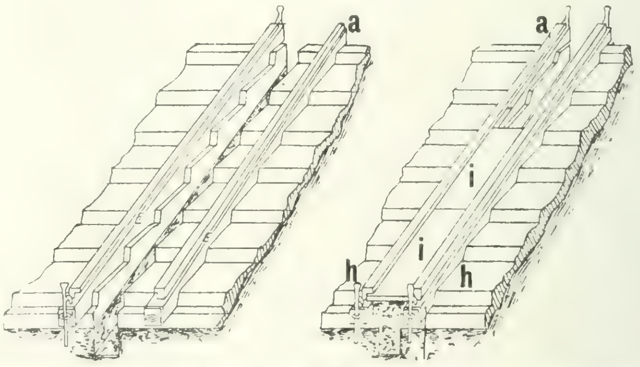


Fig. 2—Inverting the Risers Shown in Fig. 1 to Cast Beams in Place After the Slabs are Poured

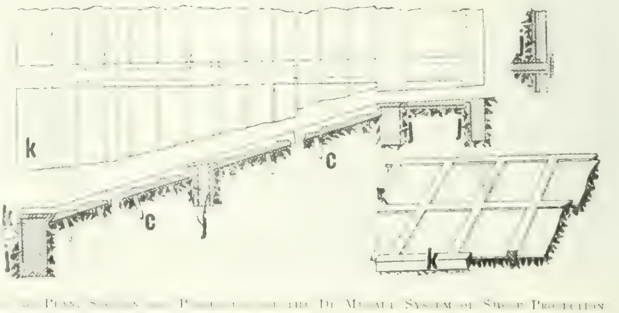


Fig. 3—Plan, Section and [illegible] the De Muralt System of Shore Protection

Preventing Cracks in Poured Cement

In the July, 1913, issue, page 35, some correspondence was published discussing methods of preventing cracks when pouring sections such as bridge balusters. In the correspondence above referred to a suggestion was made that the concrete should be poured in as far as a projecting top and allowed to set before placing the top part of the baluster. It is also suggested that contraction cracks might be caused by handling the mixture too wet.

A letter recently received from a contractor in Lebanon, Pa., discusses the matter as follows:

"The cracking in the concrete is easily overcome in the following way: The molds should be oiled well with coal oil. The concrete should be mixed to a consistency where it will run freely, using about 1:2 mix. The mold should be poured as rapidly as possible and when it is full it should be puddled and stirred with a light iron rod; a 1″ by ⅛″ is a good size.

"The outside of the mold should then be rapped with a hammer so as to settle down the concrete. It will be found, then, that it is necessary to put in more concrete to fill up the mold. It should be rapped thoroughly every 15 or 20 minutes until it has taken its initial set. No trouble ought to be experienced when this method is followed."

An exceedingly heavy rain storm of July 20 and 21 along the line of the Los Angeles aqueduct developed a trying test on the aqueduct construction. One and one-half inches of rain fell, according to Ch. Eng. Mulholland, and the water came down Jawbone canyon 4′ in depth. The Cameron canyon was also flooded and the adjacent section of the aqueduct was covered with 9′ of debris.

The roof of the covered portions of the aqueduct is designed to carry a load of 6′ of gravel. The washed down material did no damage and caused no caving in of the roof. It is a very satisfactory test on the construction.

A Pressure Test with Wet Concrete

In order to determine, if possible, proper figures of strength and factors of safety to be used in designing forms, the Aberthaw Construction Co., Boston, Mass., has recently made some tests of the pressure of wet concrete. The tests were made on small area columns where it was easy to obtain a high pressure head in a short time. They are, therefore, mainly applicable to that condition of laying concrete. Besides this, however, the tests are of considerable value in connection with general form design, particularly in showing that somewhat heavy forms are more than justified.

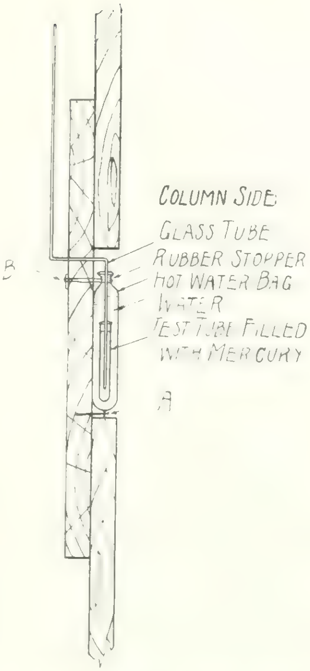
The Apparatus Used

In each column tested were placed six ordinary hot water bags at vertical intervals of 3′. These bags were filled with water and carried inside a test tube containing mercury and having a glass tube run through the rubber stopper in the neck of the hot water bottle to a point well below the level of the mercury in the test tube. This glass tube was in each case bent out to go outside the column siding and then bent up again as shown in Fig. 1. The mercury levels indicated on the glass tubes were read on each tube after the column was filled with concrete.

As the concrete is poured it presses directly against the surface of the hot water bag. The reaction is transmitted to the water in the bag and is equal to the concrete pressure. This water exerts the same pressure on the surface of the mercury in the test tube, forcing mercury to rise in the small-bore glass column. The pressure in inches of mercury, which is readily translated into lbs. per sq. in., is given by the difference in level between the mercury in the test tube and that in the column. As the pressure is figured from a fluid head the area of the bag exposed has no influence.

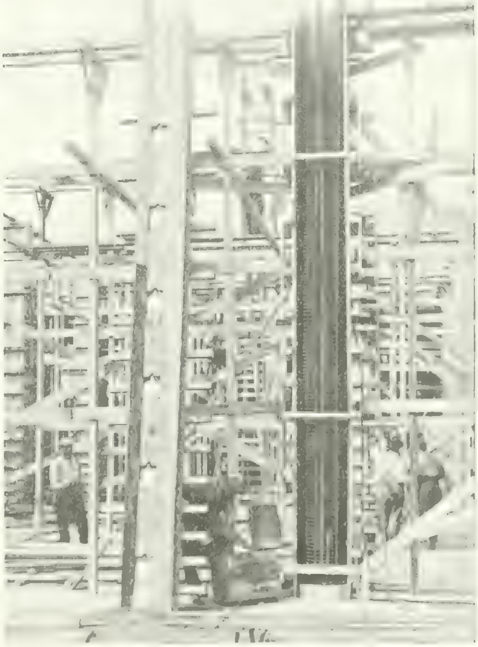
As the mercury in the test tube is not visible after the concrete is poured it was necessary to calibrate in order to determine the pressure necessary to cause a rise of 12″ in the small tube. The test tube was filled with mercury to within 1″ of the top and put in the bag. The top of the tube was then found by feeling and the level of mercury determined as 1″ lower. This level drops as the mercury in the tube goes up, the amount being determined by forcing the mercury up in the tube a distance of 12″ and measuring the depression in the level in the test tube. From this amount a correction was made to fit each case.

In Fig. 3 will be seen the arrange-



[illegible]

[illegible]



[illegible]

ment of the bags on the test face of the form while the reinforcing of the columns is shown to the right of the bags. Each column was 20" x 29" and about 20 ft. high. This was in no sense a laboratory test, but was carried out with sufficient care and precision for all practical purposes. The columns were in a building being erected by the Aberthaw Construction Co. for the Boston Woven Hose & Rubber Co. at Cambridge, Mass.

Conducting the Test

The first column was poured entirely in 9 min. by means of dump cars, the mixture being 1:2½:5, using sand and 1-in. crusher run stone. The mixture was fairly wet, but no effort was made to get anything except a natural working condition. The second column happened to be one designed for carrying a water tank. As a result, the mixture was quite rich, being 1:1:1, with the same material. This column was poured entirely in 14 min. The size of stone and relative amount of water were about the same as in the first column.

In each case the highest point of the mercury column was read, this representing, of course, the maximum pressure. The results obtained are shown in the accompanying table where the pressure in lbs. per sq. ft. was found by multiplying the reading of the mercury column by the proper constant. The "hydraulic equivalent" is the quotient of pressure divided by head.

These results checked each other quite closely. It is seen that the green concrete exerts a pressure nearly equal to that of a perfect fluid, and this in spite of the type of reinforcing (pitch of spirals 1½-in.) used on these columns. The pressures in the lower part of the columns do not show quite full liquid pressure, due to the fact that the first concrete put in begins to set before the last concrete is poured.

TABLE SHOWING PRESSURES IN CONCRETE COLUMNS DURING CONCRETE PLACING

Description of concrete		Head (ft.)	Pressure (lb. per sq. ft.)	Hydraulic equivalent (lb. per cu. ft.)
	No. 1 Column	3.08	460	149
Time of pouring, 9 min.		6.08	900	148
Mixture, 1:2½:5		9.08	1330	146
Stone, 1-in. run of crusher		12.08	1710	142
Wt. of mixture, 152 lbs. per cu. ft		15.08	2110	140
		18.08	Tube broke	
	No. 2	2.75	407	148
Time of pouring, 14 min.		5.75	840	146
Mixture, 1:1:1		8.75	1280	146
Stone, 1-in. run of crusher		11.75	1700	145
Wt. of mixture, 149 lbs. per cu. ft		14.75	2080	141
		17.75	2450	138

Work is going actively forward on the plant of the Universal Portland Cement Co. at Duluth, Minn. A 60-acre tract has been cleared and one of the buildings is well under way. The entire plant is scheduled for completion within two years.

Lockwood, Greene & Co., archs. and engrs. for industrial plants, Boston, have established a Canadian office under the name of Lockwood, Greene & Co. of Canada, Ltd., with headquarters in the McGill Bldg., Montreal.

Concrete Organizations, Officials and Conventions

American Concrete Institute, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa. Convention, Chicago, Feb. 16-20, 1914.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Building, Washington, D. C.

American Road Builders' Association, Secretary, E. L. Powers, 150 Nassau St., N. Y. C. Convention and Exhibition, First Regiment Armory, Philadelphia, Dec. 9-12, 1913.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Building, Philadelphia, Pa.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy.-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill. CHICAGO Show, Coliseum, February 12-21, 1914.

Iowa Association of Cement Users, Henry H. Dean, Glenwood, Ia., Secretary.

Nebraska Cement Users' Association, Secy.-Treas., Frank Whipperman, Omaha, Neb. Convention Feb. 2-4 and Show Jan. 30 to Feb. 4, 1914, Omaha.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Bldg., Minneapolis, Minn.

Treating Cisterns to Eliminate Taste From Water

New cistern walls, a week or so after completion, should be thoroughly scrubbed and rinsed and the scrub water carefully removed. Some cistern builders do this and practically get rid of "the hard taste" of cistern water. This treatment might be improved by using a 1:5 or 1:10 solution of commercial hydrochloric (muriatic) acid and water as the wash. This would remove the thin film of neat cement, would expose the aggregate, and would thus reduce the actual cement surface (which gave the taste) to the minimum. When walls are treated this way the water loses its disagreeable flavor in a couple of weeks.

A Great Gathering of the "Business Press."

The convention of the "Federation of Trade Press Association in the United States" (to give it its full clumsy title) held at the Hotel Astor, N. Y. C., Sept. 18-20, was a remarkable gathering in many respects. Remarkable in numbers, remarkable in the quality of the addresses delivered, and most of all remarkable for the earnest spirit shown—the serious purpose of the men who guide the destinies of the trade press of this country to leave nothing undone that will make for the betterment of their periodicals.

No one who attended this great gathering—over 500 names appeared on the convention register—could doubt that the "Business Press" has come into its own or is rapidly doing so. Among the words of advice handed out by the speakers from other lines of publishing endeavor the most sincere and earnest contained this message: "You trade publishers don't know your own strength—you don't appreciate sufficiently the value of your own papers and the great service they are doing. You have the greatest and most efficient engine of publicity in the world and you should let the world know what you have done and can do."

The key-note of the convention summarized in the declaration of principles adopted unanimously was the demand for truth and justice in all relations among publishers, advertisers and readers. That the trade press must be kept like Caesar's wife—above suspicion—was the universal sentiment.

A very significant fact was that the great success of the gathering was due in large part to the large amount of display advertising space donated by the publishers of trade and class mediums for advertising the convention.

Production of Sand and Gravel

The U. S. Geological Survey has just issued an interesting summary of the figures showing the increase in the sand and gravel output in the past year; 1912 was the second largest in the history of the industry. The increase of 1912 over 1911 was 1,471,918 short tons and $1,922,972 in value, the total tonnage for 1912 being 68,318,877 short tons, valued at $23,081,555. A great part of this gravel and sand was used in the increasing bulk of concrete made during the year, and shows, as does the increased output of crushed stone, the growing demand for these materials for concrete construction. It is interesting also to note in connection with the industry the development of many sand deposits of the higher grades, where sands for special purposes are produced, such as the white sands for sidewalk use and the high-grade sands for cement testing purposes. This growth and the development of gravel beds where pure gravels suitable for the best concrete can be obtained, are one of the features of the period.

Concrete Roads

(Continued from p. [illegible])

about 25 ft. separated by expansion joints, there being 209 sections to the mile. Most of the sections were separated by four thicknesses of tar paper separated by thin boards which it was planned to remove as the work progressed, though many of the boards are still in the pavement. Four of the joints were protected by pairs of steel angle bars, separated with tar paper and placed with one leg of each angle back to back so that the other leg of each bar was flush with the surface of the concrete, thus covering a space of about 4½ in. at the joints. The concrete wears slowly on either side of the angles, leaving a raised joint that is slightly noticeable when driving over the pavement. This was an experiment which has not been repeated.

Of the 209 sections constituting the first mile on Woodward Ave., 80 showed longitudinal cracks, 32 transverse cracks and 2 diagonal cracks while 46 sections were recorded as having holes, making a total of 160 sections which are more or less imperfect, or 76.5 plus % of the entire mile.

The remaining portion of Woodward Ave., 252 sections, was built in 1910, using the same materials and the same mix. No blind curb was used and the crown was reduced to 2″. The soil on this section is considerably more sandy, especially toward the north end.

On this portion of Woodward Ave., 29 sections have longitudinal, 22 sections transverse, and 6 sections diagonal cracks. 11 sections have holes, making a total of 68 defective sections or 27 plus %, as compared with [illegible] in the first mile.

Gratiot Avenue

On Gratiot Ave. in the season of 1910, 9,000′ of 16-ft. concrete roadway were built. On this pavement gravel and sand were used for the aggregate and a one-layer concrete having a 1:2:4 mix was laid. The soil is a clay loam and rather heavy. This road was not completed until late in the season and was opened to travel in November. It immediately pitted and looked rough and has been covered with a surface treatment of refined tar and fine gravel. It was re-covered this season, using a rather light grade of tar (Tarvia A) but it already shows some tendency to scale off. The experience in some other places leads the Commission to believe that a heavier grade of tar gives better results.

Beyond this portion of the roadway 326 sections of the same width concrete were laid in 1911 reaching to the county line. Washed pebbles and sand were used for the aggregate in a 1:1½:3 mix, one-course concrete 7″ deep being laid. The records for this piece are as follows: Longitudinal cracks, 11; transverse cracks, 10; diagonal cracks, 3; holes, 6; showing a total of only 30 defective slabs or 9.2 plus %. The traffic count on this road, taken at the county line, shows 507 vehicles daily, 65.8% of which are motor driven.

Grand River Avenue

On the Grand River road 61 sections of two-course concrete, the same as laid in the first mile of Woodward Ave., were built in 1909. The soil is a clay loam. The records show 11 longitudinal cracks, 2 transverse cracks, 1 diagonal crack and 3 holes, a total of 17 defective slabs or 27.9 minus %. The traffic count showed 1,064 vehicles, 56.5% of which were motor cars.

In 1910, 341 more sections were added to Grand River Ave. under contract, the specifications being the same as for the north end of Woodward Ave. Of these slabs 33 became more or less pitted, some having quite large holes. They have been repaired by covering with refined tar and stone chips so that no defects could be observed at the time of the count, hence only 308 are shown in the table. The defects noted are as follows: 59 longitudinal, 20 transverse, 29 diagonal cracks and 46 holes, a total of 154 defective slabs or 50%.

In 1911, 515 additional sections of one-course concrete were placed on the Grand River Road. Washed pebbles and sand were used for the aggregate with a 1:1½:3 mix. The Baker[1] steel joint was used in all of this work except the first six sections. The defects noted are as follows: Longitudinal cracks, 8; transverse, 26; diagonal, 3; and holes 5, making a total of 42 defective sections or 8.2 plus %.

In 1912, 1,208 more sections were added to Grand River Ave., reaching to the line between Wayne and Oakland counties. The count on these sections shows as follows: 66 longitudinal cracks, 37 transverse cracks, 6 diagonal cracks and 5 holes, making a total of 114 defective sections or 9.4 plus %. The soil grew more sandy as the road extended westerly, considerable stretches being almost free from clay or loam.

Michigan Avenue

On Michigan Ave., 481 sections of

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[1] R. D. Baker Co., Detroit, [illegible]

WAYNE COUNTY — CONCRETE ROADS — TABLE-1.

NAME OF ROAD	NUMBER OF 25 FT SECTIONS	WIDTH	DEPTH	AGGREGATE	MIX	YEAR BUILT	SOIL BUILT ON	TRAFFIC COUNT 24 HRS AVERAGE 1 WEEK	% MOTOR DRIVEN	% HORSE VEHICLES	DEFECTIVE SECTIONS: LONGITUDINAL CRACKS	TRANSVERSE CRACKS	DIAGONAL CRACKS	HOLES	TOTAL NUMBER	TOTAL %
WOODWARD AVE	209	18′	6½″	CRUSHED COBBLES SAND	-2½-5 1-2-3	1909	CLAY LOAM	2160	88.1-	11.9+	80	32	2	46	160	76.5+
WOODWARD AVE.	252	18	6½″	CRUSHED COBBLES SAND	1-2½-5 1-2-3	1910	SAND LOAM				29	22	6	11	68	27.0-
GRATIOT AVE	326	16′	7	WASHED PEBBLES SAND	1-1½-3	1911	CLAY LOAM	507	65.8+	34.2-	11	10	3	6	30	9.2+
GRAND RIVER AVE	61	18	6½	CRUSHED COBBLES SAND	1-2½-5 1-2-3	1909	CLAY LOAM	1064	56.5+	43.5	11	2	1	3	17	27.9
GRAND RIVER AVE	308	16	6½	CRUSHED COBBLES SAND	1-2½-5 1-2-3	1910	CLAY LOAM				59	20	29	46	154	50.0-
GRAND RIVER AVE	515	16′	7″	WASHED PEBBLES SAND	1-1½-3	1911	SAND LOAM				[illegible]	26	3	[illegible]	42	[illegible] *
GRAND RIVER AVE	1208	16′	7″	WASHED PEBBLES SAND	1-1½-3	1912	SAND LOAM	352	66.5	33.5+	70	44	[illegible]	5	132	[illegible] *
MICHIGAN AVE	481	17′-8″	6½	WASHED PEBBLES SAND	1-2-4	1910	CLAY LOAM	1009	[illegible]	32.5-	[illegible]	48	[illegible]	21	311	64.6+
MICHIGAN AVE	1570	18 16	7″	WASHED PEBBLES SAND	1-1½-3	1911	SAND LOAM				[illegible]	80	42	14	355	22.6+
RIVER ROAD	149	15	6½	WASHED PEBBLES SAND	1-2-4	1910	CLAY	538	78.3+	[illegible]	[illegible]	5	6	2	62	41.6+
RIVER ROAD	434	15	7	WASHED PEBBLES SAND	1-1½-3	1911	CLAY				[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]
RIVER ROAD	213	15	7	WASHED PEBBLES SAND	1-1½-3	1912	CLAY				4	[illegible]	4	0	26	[illegible]
RIVER ROAD	208	15′	7	WASHED PEBBLES SAND	1-1½-3	1912	CLAY				17	[illegible]	0	0	21	[illegible]
FORT ST ROAD	450	12	7	WASHED PEBBLES SAND	1-1½-3	1912	CLAY				0	19	[illegible]	1	[illegible]	[illegible]

*CORRECTED TO OCT 22 1913

concrete 15' wide were laid using washed pebbles and sand for the aggregate in a 1:2:4 mix. The soil for the most part is a sandy loam, but a little heavy. The count shows as follows: 219 longitudinal cracks, 48 transverse cracks, 23 diagonal cracks, 21 holes, making a total of 311 defective sections or 64.6 plus %. The traffic count shows 1,009 vehicles, 67.5% of which were motor driven.

In 1911, 1,570 sections were added to this piece of road, using washed pebbles and sand for the aggregate and a 1:1½:3 mix. The soil over which this pavement was laid is a sandy loam running into light sand at the west end. The count shows the following: 219 longitudinal cracks, 80 transverse cracks, 42 diagonal cracks, 14 holes, making a total of 355 defective sections, or 22.6 plus %. In 1912 this road was paved to within 1¼ miles of the county line, and this year completed to the county line, but no record was taken farther west than the east limit of the village of Wayne.

River Road

In 1910, 149 sections of concrete 15' wide and 6½" deep were laid on the River Road, using gravel and sand for the aggregate and a 1:2:4 mix. The soil over which this road runs is for the most part heavy clay. The count shows as follows: 49 longitudinal cracks, 5 transverse cracks, 6 diagonal cracks and 2 holes, making a total of 62 defective sections or 41.6 plus %. The traffic count shows 538 vehicles daily, of which 78.9% were motor driven.

In 1911, 434 sections were added to this road some distance below the village of Trenton. The pavement was 15' wide, 7" thick, built of washed pebbles and sand for the aggregate, using a 1:1½:3 mix. The count for this stretch of road shows as follows: 165 longitudinal cracks, 17 transverse cracks, 13 diagonal cracks and no holes, a total of 195 defective sections or 44.9 plus %.

In 1912, the gap between this piece of road and the southerly limits of the village of Trenton was closed in with a pavement similar to that just described, comprising 213 sections. The count on this piece shows defects as follows: 14 longitudinal cracks, 8 transverse cracks, 4 diagonal cracks and no holes, making a total of 26 sections or 12.2 plus %.

The same year there was added to the south end of the work done in 1911 something over two miles of concrete roadway, but of this only 208 sections were counted. Of the sections counted, 17 show longitudinal cracks, 9 transverse cracks, no diagonal cracks and no holes, a total of 21 defective sections or approximately 10%. The soil of the entire road was heavy clay.

Fort Street Road

In 1910, one-half mile of gravel concrete [illegible] mix, 12 ft. wide and 6½" deep was built on Fort St. This concrete like that already referred to on Gratiot Ave., was built rather late in the season and was opened to traffic in November. It immediately pitted to such an extent that it has since been coated with refined tar and fine washed gravel, about ¼" in size. This covering makes an excellent surface and wears fairly well. Of course it was impossible to observe any further defects in the concrete at this time. Continuing south, in 1912, 450 sections of concrete 12 ft. wide, 7" deep, and of 1:1½:3 mix were added. The count on this piece of road follows: Longitudinal cracks, none, although another observer has reported there are 2, transverse cracks, 19, diagonal cracks, 9, and holes, 1. Total defective sections, 29, or 6.5 minus %.

From the foregoing it is strikingly apparent that the percentage of defects varied greatly in the different roads. A careful study of this variation in connection with the age of the pavement will soon convince one that mere age has not produced the defects noted. For example, 252 sections built on Woodward Ave. in 1910 show but 27% defective slabs, while 308 sections built on Grand River Ave., the same year under the same specifications, shows 50% of defective slabs. There are two noticeable differences. Grand River Ave. was built by contract on a clay loam soil while the portion of Woodward Ave. named, was built by day labor under the direct supervision of the engineers of the County Road Commission, on a soil more sandy and, presumably, with a little better sub-drainage. Again 481 sections built on Michigan Ave. the same year with sand and pebbles for the aggregate and a 1:2:4 mix show 64.6% of defective slabs. This was on clay loam soil. We might also mention 149 sections built on the River Road in 1910 on heavy clay soil, under the specifications last named, which show but 41.6% of defective slabs.

The most noticeable feature concerning these defects is that the longitudinal cracks almost always appear in groups, seldom singly. This indicates that there must be some local conditions in the foundation, due to insufficient drainage, soil conditions, newly made fills or uncompacted sub-grades that cause these defects. Longitudinal cracks almost invariably appear on fills and on cuts, apparently with as much frequency in the latter as in the former. It would seem that cracks on the fills are due to the settlement of the embankmeent, and in the cuts the presence of water and frost in the sub-grade. Briefly, the writer's opinion is that these cracks are due, first, to the settlement of the newly made fills, and second, to water that has not been completely removed from the sub-grade, plus frost. If these causes could be thoroughly eliminated it would seem possible to build concrete roadways to the width of 15 ft. or 16 ft., where sufficient expansion joints are used, without fear of trouble from longitudinal cracks.

It has been argued by the Morse-Warren Engineering Co., in a recent publication, that it is impossible to build concrete pavements (wider than 12 ft.) which will remain free from longitudinal cracks without using longitudinal joints, unless the pavement is so thick as to make the price practically prohibitive. The table accompanying this report which shows 450 sections of 12-ft. roadway on the Fort St. road would seem to bear out this assertion, but a mile of concrete on the Eureka road, which the writer did not get time to inspect, shows a great number of longitudinal and transverse cracks in a 12-ft. concrete roadway, where the soil conditions are the same as on the Fort St. road referred to. The only apparent difference is that the former is a 1:2:4 mix and the latter a 1:1½:3 mix, washed pebbles and sand being used for the aggregate in both cases.

But long stretches of pavement 16' wide and now two years old on Grand River and Michigan Ave., which show no longitudinal cracks, would seem to prove that this statement is not necessarily true and that a sufficient amount of money spent in compacting and draining the foundation or in reinforcing the concrete over newly made fills, would produce pavements free from the objectionable longitudinal crease, whether natural or artificial. Most persons are agreed that transverse cracks are almost always due to defective expansion joints. It has been thoroughly demonstrated, both theoretically and practically, that 25' is frequent enough for the expansion joints, and it is quite possible that they might be placed farther apart with safety,—probably not less than three joints to 100'.

The diagonal cracks are doubtless due to causes which are a combination of those noted under longitudinal and transverse cracks. Many diagonal cracks were noted where the corners only were broken off, frequently on adjoining corners of adjacent slabs, indicating that the slabs were united through the expansion joints with a bond stronger than the tensile strength of the concrete on either side of the joint.

The holes noted are perhaps of less importance than the different kinds of cracks. In a few instances they are rather large, sometimes a sq. yd. or more in area, but such places are very rare and most of the holes noted are due simply to some foreign substances getting into the concrete, like clay, wood or some fragment of an inferior rock that might chance to be a part of the aggregate. This was more noticeable where crushed cobbles were used for the coarse aggregate than where washed pebbles were used.

Any one familiar with the quality of rocks which constitute Michigan cobbles will understand that the principal objection to the material for an aggregate on concrete roads is the varying qualities of these rocks, ranging from soft to hard granite, quartzite and trap. A study of the roads where these materials have been used shows much more wear in the spots where the softer rocks happen to be at the surface.

Up to the present time the defects noted, except the pitted conditions of the concrete roads which have been resurfaced in the manner already described, are not serious and are not *causing any additional expense for upkeep...In the past two years the expansion joints on all the old work, whether reinforced or not, have been coated with refined tar and sand once a year. Thus far, the cost has ranged be-$50 and $100 per mile, depending on the distance of the work from the base of supplies. These repairs are proving adequate and satisfactory, and while the defects noted are something of a reflection on the present method of building concrete roadways they are really no reflection on the use of concrete as a suitable material for making hard and durable surfaces over our country highways wherever traffic conditions warrant, and the community has the ability to pay the cost of high class road surfaces. There is no question as to the necessity of some form of very permanent roadway near the city of Detroit, neither is there any question as to the ability of Wayne county to pay for a roadway that is good enough and permanent enough to meet the requirements of its traffic. In the writer's opinion, Wayne county has made no mistake in choosing concrete as a paving material for its main roads.*[2]

Reinforced Concrete Chimneys for Power Plant at Havana.

The Havana Electric Ry. & Power Co. has now under construction a 40,000 h.p. plant in the harbor of Havana. At present there are three power plants in the city of Havana; one being for the railway, the second an independent power plant and the third a gas and electric plant. These three plants have recently been consolidated by American interests and now a new plant is being constructed to take care of the power required for all such work in Havana. At the completion of the plant under construction the other plants will be dismantled.

Of interes in this connection is the fact that the Weber Chimney Co., Chicago, has recently closed contract with the Havana Electric Ry. and Power Co., C. W. Ricker, asst. mgr. and ch. engr., for four reinforced concrete Weber chimneys.

For this plant all coal is imported from the U. S. at a considerable expense. Consequently, the engineers in laying out the plant have endeavored to secure a most economical boiler installation. Each of the four chimneys will be 275′ high with a 14-ft. inside diameter at the top; the foundations are a mat 40′x40′ and 6′ thick, reinforced both parallel to the sides and diagonally, and rest on wood piling.

American cement is being used throughout this work, and precautions are being taken to prevent any retards in the set of the cement due to the unusual element in the water. While there is a cement mill in Havana, the chimney contractor, as well as other contractors on the island doing large work, prefers American cement. The cost of the native and the American cement are practically the same, being approximately $2.85 per bbl.

A Conference on Farm Concrete Work

One of the essentials of farming is that there shall be farm structures conveniently located. Farm profits are directly affected by the character of the farmer's buildings. His success in raising animals and even the health and happiness of his family depend upon the general sanitary condition of the entire surroundings. The realization of these facts has led to a widespread and rapidly increasing demand among farmers for better buildings and other improvements, and for dependable information on the use of materials of which to build permanent and sanitary structures. This demand has been recognized by Farmers' Institutes and extension workers throughout the country, and splendid results have already been accomplished in a number of states.

Manufacturers have recognized this for several years, and the Universal Portland Cement Company, Chicago, especially, is employing speakers to go before the various Farmers' Institutes and educate those in attendance in the better applications and uses of concrete. To render more definite and to extend this work further the Universal Portland Cement Co. held in the latter part of August a conference under the title of "Conference of Farmers' Institute and Short Course Workers on Permanent and Sanitary Farm Improvements." At this conference the Universal Company brought together the speakers at the different Farmers' Institutes, Short Course workers, Professors of Agriculture and Mechanical Engineering in Agricultural Colleges and other practical men who are interested in better agriculture, and who, in the very nature of things, would necessarily be interested in concrete as a permanent and sanitary farm structural material. The conference, which lasted from Aug. 18 until Aug. 23, covered comprehensively many uses of concrete. The week's work was in general divided into laboratory work, inspection trips and papers and discussions. The field laboratory work covered a careful study of concrete aggregates, methods of mixing, storing and handling cement, tools and equipment, etc.

On the inspection trips all points of interest within the vicinity of Chicago were visited, and the evenings of every day were given over to discussions and papers.

This conference, which was in charge of C. W. Boynton, Insp. Engr. of the Universal Co., was entirely successful. While about 50 were expected, those in attendance actually numbered over 125. These delegates, while presumably men well informed on concrete developments, were put through a week's hard work and went away with a much better, broader and more definite understanding of the wonderful adaptability of concrete.

The Universal Portland Cement Co. deserves great credit for the way in which it conducted this conference without emphasizing in any way a particular brand of cement. The emphasis at every point was placed on concrete, good concrete and a good Portland cement, wisely used. The American people as a whole are just beginning to realize what concrete actually means to the farmer and to those men who spent boyhood days on the farm and are familiar with the hard grueling work of keeping farm buildings, porches, wells, barns, etc., in repair, will be astonished at the change on the modern farm. Concrete is used on every hand. There are almost no repairs needed and the old place seems transformed. Such a conference as this of those men who are doing their best to educate farmers to these uses will have lasting results in more and better concrete work.

NEW BOOKS

Index to Proceedings, Vol. I-XII, Am. Soc. for Test. Mat., Philadelphia. 9¼″ x 6¼″, cloth bound, 158 pp.

From 1898 to 1912 the Am. Soc. for Test. Mat. has made for itself a wonderful place in American and international engineering and scientific circles. The publications of the Society have been in every respect the last word on the subject covered, and the index for the twelve volumes covering the fourteen years' work, which is now published, neatly bound in blue cloth, presents a comprehensive epitome of work accomplished. The Index contains a subject index and author index and also the contents of the proceedings by individual volumes. Whether or not the engineer or student has the complete Proceedings available he will find the Index of great value in gathering data on various technical and engineering subjects.

Smoley's Parallel Tables of Logarithms & Squares—Seventh edition. By Constantine Smoley, C. E.; published by McGraw-Hill Book Company, N. Y. C., 7″x5″, leather bound, 174 pp., price $3.50.

Smoley's tables have been standard engineering equipment for a good many years. This last edition presents several additional improvements in way of type arrangement, additional tables, etc. The book is well and substantially bound in limp leather and is printed on a good quality of paper. These are tables which should be of value to every engineer.

Standard Specifications for Exterior Plastering—Associated Metal Lath Mfrs., Youngstown, O. 9″ x 6″, paper bound, 12 pp., illust.

These specifications summarize a good many years' careful work investigating the requirements of good permanent stucco work, and cover the subject completely and comprehensively.

Allentown, Pa., is proud of the completion of the Lehigh Valley Traction Co.'s bridge between the city and South Allentown. The big structure already described in CONCRETE-CEMENT AGE, has cost about $500,000. It is 2,600′ long, 46′ wide and 122′ high.

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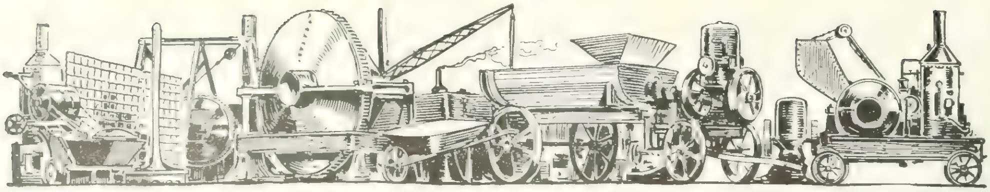
[2] [illegible]



New Equipment, Methods and Materials

The forward progress of any industry is measured by the tools with which it works, and the engineer-manufacturers who are developing new and better methods and materials, merit recognition and co-operation. In this department are published brief descriptions of the new developments of the field

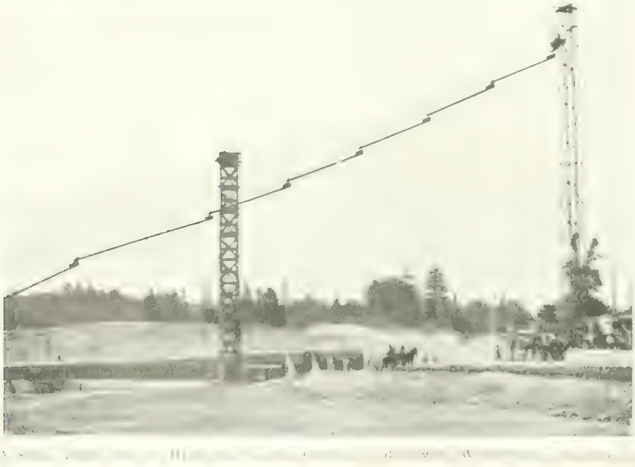
An Interesting Gravity Chute Installation

On a contract which the city of Baltimore has with C. W. Lane & Co., of Atlanta, Ga., for the construction of a filtered water reservoir, equipment has been installed recently consisting of a 135-ft. Lakewood[1] steel tower carrying a 725-ft. cable, from which are suspended 340′ of chutes. The pitch of the chutes in this case is about $4\frac{1}{2}''$ to the foot of chute. The installation is the first of any magnitude that has been introduced at Baltimore and the inspectors were apprehensive about the chuting of concrete, expecting to find separation of materials. On the contrary, however, the concrete delivered at the end of the line of chutes was of good quality, notwithstanding the fact that washed gravel, which shows the most pronounced tendency to separate, was used.

In a recent letter to CONCRETE-CEMENT AGE, D. L. Wadsworth, of the Ohio Ceramic Engineering Co., describes this installation, and gives some interesting notes on its operation. It takes about two minutes for the concrete to flow 340′ at the pitch established on this work. This distributing plant has a comfortable capacity of 500 cu. yds. of finished concrete in an 8-hr. day. The hoisting engine and mixer that are used in connection with the distributing plant restrict this capacity materially, and it will not be possible for the contractor to keep forms constructed in advance so that any such quantity of concrete can be placed. As a matter of fact, if the contractor places 150 cu. yds. of concrete in 8 hrs. under the present working conditions he will be doing well, but this limitation is not due in any way to the tower and chuting factors of his equipment.

This is cited in this way because it is such an important factor in determining the relative cost of chuting concrete as compared with handling it by carts, cars or other means. There is absolutely no question about the economy of chuting concrete where distances exceed 100′, and there are innumerable cases where it is the most economical manner of placing the material at shorter distances than this.

So far as quality of concrete goes, the best concrete that has ever been laid has been placed with chutes, the quality depending entirely upon the pitch that is given to the chutes. Nearly every beginner at the chuting process pitches the chutes entirely too steep, so that the concrete moves through them in intermittent batches at a very rapid rate. This is entirely contrary to the theory of concrete chuting, the aim of which should be to keep a continuous stream in the chutes moving as slowly as it will move.



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Reinforced Fireproofing for Structural Steel

Preventing cracks in the fireproofing around structural steel is always an important matter, and of interest in this connection is a material known as "S. M. C.," short for "Standardized Metal Caging," which has been developed by the Mitchell-Tappen Co., N. Y. C. The name "caging" has been chosen because the steel is actually encaged in a continuous wire form, the various parts of which are always at a desired uniform distance from the face of the steel.

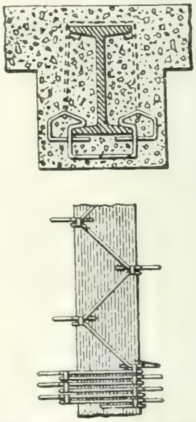

FIG. 1. PLAN AND SECTION OF FIREPROOFED I-BEAM SHOWING WIRE CAGING.

The material is manufactured of No. 12 galvanized open hearth wire in lengths measuring 6′ as they come from the machines and which length of collapsed caging represents 100′ of protection when installed. The lower part of Fig. 1 shows from below the way the caging comes onto the job. Above is shown, the I-beam in section, and the caging in elevation The connections are made by electric welding and a special form of connection member is used so that sufficient heat is produced at the junction of the parts to re-anneal the wires close to the weld, thus insuring that the caging when expanded will bend only at this point and not spring back when once drawn to its permanent position. The constant size of the expansible connecting portion insures the uniform spacing of the caging regardless of the size of the beam. Caging is designed so that each size will conveniently fit a variation of 1" in the width of flanges, and when expanded consecutive hooks will automatically space themselves at an average of 6" centers while, owing to the hooks being staggered on the opposite sides of the beam, there will be a hook and a cross-member every 3".

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[1] [illegible]

The accompanying illustrations show the essential features of this material, but it should be pointed out that the transverse, diagonal, securely anchored reinforcement across the bottom of the beam offers no impediment to the concrete flowing under the bottom flange. This is important from a practical consideration of the problem. Another feature is the labor cost. The caging as shipped means over 16 times its area in protection in place on the structural steel. For a 16-ft. beam the laborer can take approximately 12" of caging, slip it over the lower flange at the end of an I-beam, secure one end of the caging and pull it out along the beam. This automatically fastens it in place and develops a caging as shown in Fig. 2. The labor cost should be very low, and the caging make for a better quality of fireproofing work.

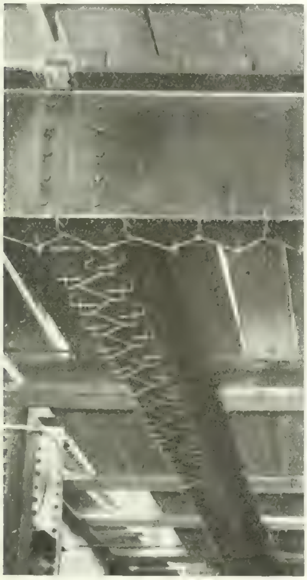


Fig. 2—Metal Caging in Place on an I Beam

* * *

Germans Adopt an American Waterproofing

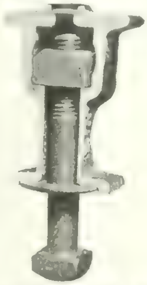
Late in 1912 the Deutche Kahneisen Gesselschaft at Berlin, Germany, purchased without the knowledge of the Trus-Con Laboratories some "Trus-Con" concentrated waterproofing paste. They submitted samples of this paste under the name of "Kanolite" to the Royal Testing Laboratories at Berlin, Germany, for a thorough test. The report of the Royal Testing Laboratories was so satisfactory to the Deutche Kahneisen Gelleschaft that they have secured from the Trus-Con Laboratories right to manufacture this material in Germany, and have given it the name of "Wassertrotz."

The waterproofing submitted to the Royal Testing Laboratories as "Kanolite," now marketed in Germany as "Wassertrotz," and "Trus-Con Waterproofing Paste, Concentrated," are one and the same material made from formulas devised by the chemical engineers of the Trus-Con Laboratories, Detroit.

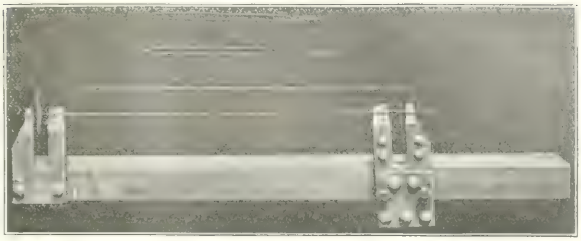
* * *

The "Security" Floor Insert

When planning a concrete building, the item of inserts or ceiling sockets for hanging shafting or other fixtures is one demanding serious consideration. With the "Security" insert, manufactured by the Security Insert Co., Philadelphia., either stud or bolt can be used, whichever is the more convenient for the work, or the more easily obtained. The thread which engages the bolt or stud is not tapped in the casting, but consists of a Standard Steel Nut. Having in view the support of maximum load, the "Security" insert is designed to afford a large anchorage in the concrete and the distribution of metal in the casting.


Cut Away Section Showing the Anchorage Method of the "Security" Insert

The accompanying illustration shows the essential features of this insert. The broad base of this insert not only assures its correct vertical position, but permits it to be solidly fastened to the form, thus avoiding the risk of disturbance recognized as one of the many difficulties encountered when using an inferior type of socket. It is readily and securely nailed to the form, avoiding the necessity of boring holes, with the consequent waste of time and lumber.


An Adjustable Steel Frame for Making Wall Ties

* * *

A Frame for Making Wire Spacers

The accompanying illustration shows a frame for making wire spacers which is used by the Blaw Steel Construction Co., Pittsburg. The frame is a heavy angle iron on which are mounted two yokes. One yoke is riveted at one end of the angle iron, the other is adjustable by means of set-screws. Long "U's" of wire, cut accurately to length, are placed on the frame, and the two ends twisted tightly together. The loops required for panels and liners are then made. This stretches the wire to a certain extent, so that all ties have practically the same length. These ties are being used to some extent in place of the steel ties heretofore used with Blaw forms. No. 12 annealed wire is used.

* * *

A Paint Paste for Concrete Work

A new material on the market for propaste. This is a paste, to one part of which can be added one part of zinc white or chalk and one part of water and mineral color and a paint is produced. One gallon of oil paste will make up 3 gals. of a paint, which will unite with masonry or cement surfaces, and, the manufacturers say, will not rub off or dust, and is further a waterproof coating. The flat colors obtainable are very pleasing, soft in tone and have met with favor in the eastern market.

An apparently good feature of this product is that it can be ready mixed as desired by painting contractors, who can purchase locally their zinc or whiting and their mineral color and do their own mixing, thereby saving transportation charges.

This material, which is manufactured by The Consolidated Cos., N. Y. C., has been used recently in the new building at 59th St. and Broadway, N. Y. C.

* * *

Electric Welded Wall Ties

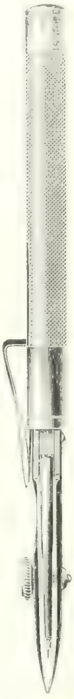
The Van Expansion Bolt Co., Chicago, is now handling the "Androck" concrete wall tie. This is a rectangular loop, approximately 2" wide and in assorted lengths, which is being used successfully in wall centering. It can be dropped right over the opposite 2 x 4s and holds the studs accurately in place without any twisting.

A Fountain Drawing Pen

Fountain pens for writing are in very [illegible] fort and the accompanying illustrations are of interest in that they show what [illegible] such a pen.

In this fountain drawing pen, which is made by Keuffel & Esser Co., N. Y. [illegible] contained in a rubber reservoir within the handle [illegible] slight pressure of the [illegible] and after a little practice the draftsman will find that he can feed ink to the pen while drawing the most exact lines.

The blades are fed with a quick opening device and are hinged so that they may be swung sideways clear of the feed tube. This allows the reservoir to be filled and makes cleaning easy. When it is necessary to fill the pen, the blades are swung to one side, the feed wire is removed from the feed tube and the lever pressed down to expel the air from the rubber container. The feed tube is then dipped into the ink and with the pressure gradually relieved from the lever the ink is drawn up into the sack; the wire is then replaced, the blades are returned to their normal position and the pen is ready for use.



A Fountain Drawing Pen

The Waterloo Cement Machy. Corp., Waterloo, Ia., has opened a N. Y. office at No. 11 Broadway, with Parker U. Cole in charge of the New York and New Jersey territory. This company manufactures the "Polygon" and "Little Wonder" lines of concrete mixers and will now carry a stock of these machines in New York for the convenience of customers.

* * *

The Cummings Structural Concrete Co. has been awarded the contract for the erection of a reinforced concrete bridge at Haights Run, near Pittsburgh. The bridge will be 327′ long and 60′ wide, with a center arch of 195′. The contract price is $109,480. The only other bidder was the Dravo Contracting Co. The estimated cost of the city engineers was $110,000.

Catalogs and other Trade Publications

Living-Stone. [illegible]

Waterproofing. Ceresit Waterproofing Co., [illegible] alogue, there are several smaller catalogues, each taking up some particular phase in the use of Ceresit. The first little leaflet is entitled "Scientific Explanation." This is followed by "Test Reports," "Specific Records of Use," "Testimonial Letters, and "The Clincher." The catalogue should be found of interest to anyone having waterproofing problems to handle.

Cube Mixers. Municipal Engrg. & Contrg. Co., Chicago. 9" x 6", paper bound, 64 pp., illust. This is an interesting catalogue in that it presents detailed descriptions of the great mixing plant used at the Panama Canal. Many other photographs of unusual construction work are shown.

Facts Concerning Reinforced Concrete Paving. Thomas Steel R[illegible] Detroit. 9" x 6", paper bound, 48 pp., illust. This booklet presents in a very convincing way the merits of the Thomas system of assembling reinforcing steel for pavement construction. In this system reinforcing rods, placed longitudinally and traversely to the road, are held in the upper and lower portions of the pavement by an attachment known as the "Thomas stool." The reinforcement for one section of roadway is fabricated adjacent to the work and placed as a unit, the plates for the expansion joints being fastened to the end of the rod. Many interesting photographs are shown.

Art Marble. American Art Marble Co., Philadelphia. 9½" x 6", paper bound, 60 pp., illust. This material is a facsimile of natural marble and is used extensively for interior work in some of our modern American buildings. The making of American art marble is a process radically different from scagliola. English Keene cement is used, mixed with colors in such a way as to produce the various tints, veins, grainings and formations of natural marble and onyx. The manufacturers state that the material has a greater tensile strength than scagliola, is lighter and makes possible a closer reproduction of the natural marble. The catalogue shows by some illustrated inserts some very interesting reproductions of some of the company's work.

Nonpareil High Pressure Coverings. Armstrong Cork Co., Pittsburgh. [illegible] paper bound, 72 pp., illus. This catalogue, which is a very artistically prepared book, presents the advantages of high pressure coverings for steam lines, boilers, breechings and all heated surfaces. The discussion of this material is gone into comprehensively.

Machines for Mixing. Snell Mfg. Co., South Bend, Ind. [illegible] folder, illus. This little pocket circular describes the latest models of Snell machines. In this mixer the drum is open and revolves at an incline and is dumped by simply tilting the drum. Several models are illustrated in the folder.

Reinforced Concrete Piling. A. C. Chenoweth, 177 Montague St., Brooklyn. 11" x 8¼", paper bound, folder, illus. This circular shows some interesting illustrations of concrete tile work in Havana harbor.

Crescent Belt Fasteners. Crescent Belt [illegible] x 8½", paper bound, illust., 20 pp. These belt fasteners are adapted to all leather, canvas or rubber belting and consist essentially of a metal plate which is riveted to either end of the belt.

Non-Fading Mortar Colors. Jamestown Paint & Varnish Co., Jamestown, Pa. 5½" x 3¼", paper bound, 8 pp. This little booklet describes the various kinds of mortar coloring materials which are manufactured by the above company. Some valuable suggestions are given as to the use of this material.

Smooth-On Iron Cement. Smooth-On Mfg. Co., Jersey City, N. J. [illegible] paper bound, 40 pp., illus. This catalogue is an instruction book covering in detail the use of this material for waterproofing, patching concrete, floors, developing bond, etc. It will be found of interest to contractors having these problems to meet.

Concreting in Cold Weather. Universal Portland Cement Co., Chicago. 9" x 6", paper bound, 38 pp., illus. This is the 1913 edition of a bulletin on this subject, which at this time of year, for a good many years, has brought to the concrete user some very good concise information on this important problem. The bulletin this year presents not only complete laboratory and practical field tests on all the factors involved in handling concrete in cold weather, but some interesting costs on this operation are presented.

Industrial Equipment. Orenstein-Arthur Koppel Co., Koppel, Pa. 11" x 8½", paper bound, 84 pp., illus. This is a loose-leaf catalog of convenient size well arranged to present the extended line of equipment manufactured by this company. Some unusual installations [illegible]

Concrete Mixers and Contractors' Equipments. Standard Scale & Supply Co., Chicago. 9" x 6", paper bound, 188 pp., illus. This catalogue covers in a very comprehensive ferent models being shown. Builders' hoists, manner a complete line of equipment turned out by this company. The well-known "Standard" mixer is described in detail, all the difgasoline engines, diaphragm pumps, builders' derricks, rock crushers, etc., are described.

The Concrete Bridge. Jno. B. Leonard and W. P. Day, San Francisco. 7" x 10½", paper bound, 40 pp., illust. This is a most artistic and well prepared booklet which, as the authors state, is published to supply information on the vast strides made in California in the use of reinforced concrete for permanent bridge construction. The authors open the book with a brief, emphatic argument for the use of concrete, saying why it is the material in bridge construction. This is followed by a series of excellent photograph reproductions covering in detail many types of bridge construction.

"Alca" Lime. Charles Warner Co., Philadelphia. 6" x 9", paper bound, 16 pp., illust. In this book the essential features of "Alca" lime are described and many interesting photographs of recent work are shown.

Rock-Ore and Gravel Handling Machinery. T. L. Smith Co., Milwaukee, Wis. 9" x 6", paper bound, 40 pp., illust. This catalogue is devoted principally to detailed descriptions of the "Telsmith" crusher, which was formerly known as the Symons gyratory crusher. Different parts of this equipment are described in detail as also are the various adaptations of these to portable crushing plants, etc.

Patent Suspended Bins. The Brown Hoisting Machinery Co., Cleveland. 9" x 6", paper bound, 36 pp., illust. This pamphlet describes in detail catenary suspended bins built with ferro-inclave sheeting and concrete. This bin is being successfully used in many large plants and interesting photographs and sketches are shown.

Reliance Reinforcing Bars. Interstate Iron and Steel Co., Chicago. 8½" x 4", paper bound, 8 pp., illust. Reliance reinforcing bars are rolled from railroad steel rail billets. This booklet shows in an interesting and conclusive way the value of this steel as reinforcing material. Standard specifications for this material are published and many photographs of interesting modern work are shown.

Low Charging Concrete Mixer. Standard Scale & Supply Co., Chicago. 9" x 6", paper bound, 32 pp., illust. This pamphlet presents completely the entire line of "Standard" [illegible] platform and cart-chargers are interesting feat- [illegible]

Chain Belt. The Chain Belt Co., Milwaukee, Wis. 9" x 6", paper bound, 8 pp., illust. This number of "Chain Belt" describes in an interesting way the work on the Manhattan section of the New York Aqueduct. Many illustrations are shown of this interesting work.

Concrete-Cement Age

Vol. III NOVEMBER, 1913 No. 5

Editorials

Conservation is not a new hobby; it is as old as creation itself. With the materials at hand, gable roofs in the past have been necessary on residences in the temperate zone. With reinforced concrete, flat roofs are a very logical construction and make for conservation of space and health. In the article on p. 197 of this issue, advantages of flat roofs are presented from several view points. There are some practical suggestions on construction written by a builder and architect who "knows how."

* * *

IN A RECENT interview an official of the Alpha Portland Cement Co. is quoted as saying that cement would soon be the equal of steel in the commercial world. Though this statement might be questioned, the rapid growth of the Portland cement industry within the past 10 years would almost seem to warrant the prophecy. On all sides concrete appears to be taking the place of other materials for building construction, for sidewalks, for road-making, and in fact for numerous similar uses hitherto undreamed of by the cement producer. Year by year cement is overtaking steel so far as output is concerned, and if concrete were taken as a unit in yards and dollars, it is possible that the figures would show very close comparative relations.

* * *

LETTERS FROM engineering circles in England begin to show an awakening to the value of concrete roadways in that country. This is especially marked since the Road Congress in London and the papers and discussions there in connection with these new roadways. It is to be hoped that some of the English engineers and others who are interested in the construction of concrete roads have taken advantage of the Road Congress just in session at Detroit not only to hear all that was said on this important subject but actually, by personal knowledge, to become acquainted with the great advances in road making shown in the many miles of Wayne County roads.

* * *

THE PAPER by Frank F. Rogers, State Highway Commissioner of Michigan, published last month and the one by A. N. Johnson, State Highway Engineer of Illinois, published in this issue, are very important in a knowledge of the development of concrete highways, the first because it presents definite information as to the weak spots which have developed in the Wayne county concrete roads, and the second because it contains a valuable discussion of these features. One thing, however, should not be lost sight of. The census of cracks and holes was not made until August, this year, when some of the pavement examined was four years old, some three years old, some two years, and some but one year old. Mr. Johnson presents a diagram showing the increase in cracks over a period of four years. The very important consideration in this connection is that the examination having been made at the end of four years' use of the roads, does not show the increase per year in cracks of each particular road. It shows that in roads four years old there are generally more cracks than in a road one year old. In spite of this showing, however, there is considerable question as to whether or not cracks in any one pavement show any marked increase in number from year to year. We are inclined to believe that this increase is not nearly so marked as seems to be indicated in the examination of the work of four entirely different years. A satisfactory knowledge of the tendency of concrete to form cracks year after year, can be learned only in an annual examination of each road. Edward N. Hines, Chairman of the Board of County Road Commissioners of Wayne county, is of the opinion that a very large percentage of cracks in any piece of concrete highway are formed within a year after construction. Mr. Johnson points to this possibility in a reference to the roads which he has watched in Illinois. Mr. Johnson is plainly of the opinion that most of the cracks are due to the sub-grade conditions and under ordinary circumstances, weaknesses from such causes might be expected to develop by the spring following the season of construction. If the Wayne county road builders had been as efficient in their methods and as nearly perfect in the selection of their materials when they built the first road in 1909 as they were when they built the roads in 1912, there is good reason to believe that the diagram of cracks would be entirely different. It is to be hoped that the Board of County Road Commissioners, which, in its 1913 report (from which we quote elsewhere in this issue) publishes an independent report of cracks in the Wayne county roads, will continue to make an annual census of this kind, so that at the end of three or four years we may be in possession of data that will be conclusive in indicating just what tendency the concrete has to continue through a period of years.

* * *

A Test of Concrete and Brick

One of the exhibits of the Universal Portland Cement Co. at the recent American Road Congress in Detroit consisted of a test by means of the paving determinator of two sections of concrete paving and two sections of brick paving with readings made under the direction of the civil engineering faculty of the University of Michigan. It is not necessary for us to describe the operation of the paving determinator, this having been done in the Dec., 1912, and June, 1913, issues, in connection with reports of tests. On the occasion of the test at the American Road Congress, there was much to gratify the adherents of brick. One section of the concrete paving, occupying one-half of the entire circle, was laid by men supplied by the County Road Commission of Wayne county, Mich., and the work was done as nearly as possible in accordance with the specifications of Wayne county, using washed sand and gravel with pebbles from ¼" to 1½" and a mixture of 1 part cement, 1½ sand and 3 parts pebbles. One-fourth of the circle was paved by the R. D. Baker Co., Detroit, using crushed Wisconsin granite as the coarse aggregate from ¼" to 1½" in size. This was also proportioned 1 cement, 1½ sand and 3 of granite. The remainder of the track was paved with brick, one section laid on a 1:5 Portland cement mortar cushion and the other on a sand cushion. Brick were supplied by I. M. Adams of the Detroit Vitrified Brick Co. The Wayne county paving was done August 17. The R. D. Baker paving was done August 22. The test was run from the evening of September 29 to the morning of October 4, not continuously, however, except during the latter portion of the test. A total of 19,315 revolutions was made and the Wayne county concrete made a very poor showing as compared with what could reasonably have been expected of it. It wore down in the course of the test as much as 1½" in some places. The granite concrete made a much better showing. The brick paving in the Portland cement mortar bed came through the test in excellent condition. The brick on the sand cushion was fast going to pieces when the machine was stopped. Aside from the fact that the concrete was altogether too green to be expected to stand such a severe test, perhaps the most striking objection shown was the fact that the Wayne county concrete appeared to have been troweled too much and to have an excess of mortar on top, the mortar not having the necessary resistance to stand the severe test for abrasion.

* * *

Who Should Pay the Quantity Surveyor

The movement for better estimating methods, which is spreading rapidly across the country, brings into the field many new and interesting factors. The adoption of a system of quantity surveying means that an entirely new profession is brought into activity, and the question naturally arises: "Who will pay the quantity surveyor?" In the *Quantity Surveyor* the bulletin of the Am. Inst. of Quantity Surveyors, this question is asked and the reply printed as follows:

> The architect selects the quantity surveyor and agrees with him that his percentage is to be upon the contract price, according to the class of building required. At the end of the bill of quantities will always be found a summary of all the different trades covered by the bill, and at the foot of the summary, after the total has been arrived at, the following will appear: "Add to the above total —% upon the total amount of same, to be paid to the quantity surveyor by the contractor, out of the first payment received."

This places the quantity surveyor in the ultimate employ of the contractor. It seems to us that while the quantity surveyor may seem to be working for the contractor in that he does the work that the contractor has heretofore done, that is, preparing the estimates, it would still be better not to have him look to the contractor for his payment. Why couldn't the owner pay the quantity surveyor directly, subtracting the quantity surveyor's fee from the first estimate drawn by the contractor? This would remove the objection of placing professional service in the pay of the contractor which might, under certain circumstances, prove a serious objection.

* * *

Concerning the Hardness of Concrete

We have always believed concrete to be hard, but a recent letter from a manufacturer of rotary electric drills has added some first-hand opinion which should be of interest to CONCRETE-CEMENT AGE readers. The electric rotary drill manufacturer states that they are prepared to supply machines suitable for drilling marble, slate or limestone, but in their experience it has been absolutely impossible to get a cutting edge to stand up when trying to drill concrete. Concrete, they state, is of an entirely different consistency and some grades of concrete are as hard as flint. A rotary cutting edge is impractical and a rock drill with an reciprocating motion is essential. This is interesting opinion of the hardness of concrete.

Concrete-Cement Age

Statement of Ownership, Management, Etc.

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There are no bonds, mortgages or other securities issued.

WALTER C. BOYNTON,
General Manager.

Sworn to and subscribed before me this 3rd day of October, 1913.

ROY MARSHALL,
Notary Public.

(My commission expires February 3, 1917.)

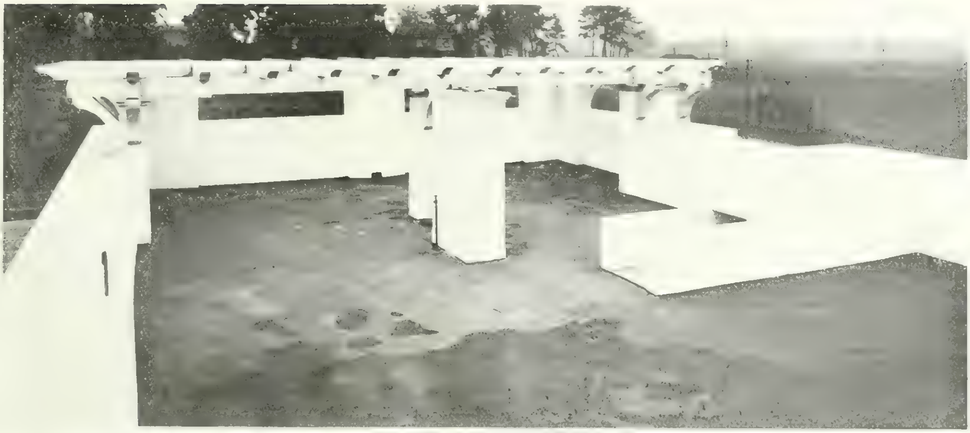

Fig. 1—This Shows One End of a Concrete Residence with a Flat Roof. A Pergola is Used Very Effectively. At the Right is the Hatch for the Stairway

In the central part of the view in the background is shown a gabled frame residence. This illustrates comparatively the advantage of a flat roof

Flat Roofs for Concrete Residences

An Outdoor Life is a Healthy Life—Flat Roofs Make for More Living Space of the Best Kind

BY P. H. BOSWORTH*

IN THE FOLLOWING ARTICLE, which was originally a letter prepared at our request in reply to an inquiry on this problem received from a Brazilian firm of builders, Mr. Bosworth discusses the subject in an analytical and interesting manner. He speaks at first hand, and from actual experience.

In considering the question of roof construction for concrete residences, several factors are involved, and in considering the relative importance of these factors, it must not be lost sight of that a residence is primarily a *home,* and every effort should be directed to making it a *real* home. From an architectural standpoint, the question has been apparently satisfactorily solved. In a way, a flat-roofed house is merely a reversion to a very ancient type of dwelling. It is from the standpoint of the builder, from the "how-to-do-it" side, that this discussion is mainly directed.

The Flat Roof Structurally

From a constructional and utilitarian standpoint, the flat roof is the only logical roof for concrete buildings. This is particularly so in hot climates, but aside from every other consideration, constructionally it is the only roof worth considering. It is the easiest to build; the cheapest to build, and as a matter of utility you gain the whole area of the building as a roof garden, sleeping porch, play grounds, etc.; an extra floor without one cent of extra expense, a place that can be utilized in a hundred ways even to the extent of a swimming pool if desired.

This, of course, could only be done in an all-concrete building where the concrete interior partitions afford the necessary support for the heavy roof slab.

The question of snow in cold countries is the only argumnet against a flat roof, and while from lack of experience of such conditions I cannot speak authoritively on the subject, yet my judgment would be that of all buildings the concrete building should be best able to withstand the additional strain put upon it by the snow load. This is due to the fact that the factor of safety in a concrete building is large and the ratio of strength between the concrete and other building materials is still larger; in other words, a snow load that would crush a frame building would have absolutely no effect on a concrete building of equal size, a building with concrete interior partitions and concrete slab roof.

There are many different types of flat roofs, commencing with the flat, solid slab, which is possibly the cheapest and most practical, and varying with the ideas of each subsequent inventor into many forms, of hollow slabs, panelled floors, joist and beam, and beam and girder construction, depending upon the builder and the type of building being erected.

The methods of reinforcement are as varied as the types of slabs but a sufficiency of bars or mesh, or a combination of bars and mesh intelligently placed, will always turn out a good slab, and one does not have to be an expert either.

Hollow or cored slabs have some advantage over solid slabs, both in construction features and utility. A properly designed hollow slab will be stronger for a given amount of material than a solid slab and the hollow portion in many cases can be used to advantage for concealing plumbing and electrical pipes and conduits and installing more, if the occasion ever arises demanding same. Pipes, etc., once buried in a solid slab, are there for better or for worse until the building is torn down. As a matter of utility a flat roof offers possibilities that can be secured in no other way. Socially it is an ideal meeting place for the family and friends; day and evening, climate permitting, it offers fresh air, view, privacy; there is more room than an ordinary porch, and the possibilities of beautifying it are only limited by the imagination and purse of the owner or occupant.

For sleeping, a flat roof cannot be excelled by the most elaborate porches; screens or other partitions can be erected quickly, open to the sky; the distance above the ground is generally a protection against mosquitoes, and the movable features of the screens and other protections insures against wind and drafts.

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*San Francisco

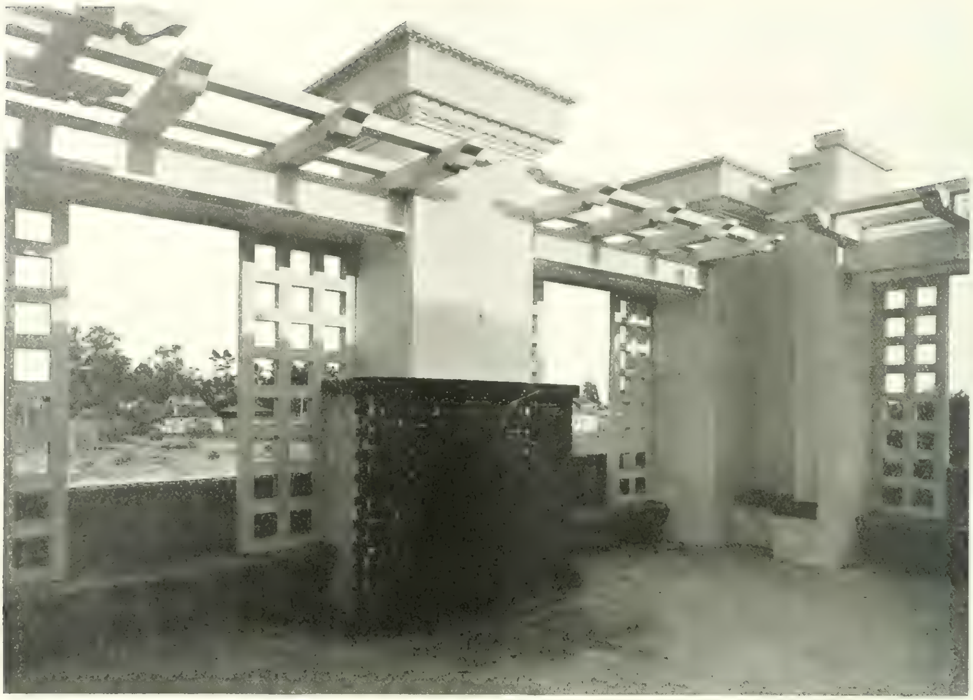

FIG. 3—A FIREPLACE AND A SEMI-PERGOLA EFFECT ON A FLAT CONCRETE ROOF
In this design lattice work and wall benches are used most effectively

The flat roof can be utilized to advantage by the operating end of the home for drying clothes and for other household economies that can be performed in the open air, free from the scrutiny of passersby. It is ideal for airing and ventilating, the hygienic sunbath for both people and things.

The Cantilever Cornice

The overhanging cornice is a projection, generally of the flat roof, although sometimes it is projected from the top of the firewalls of the building. Its principal use is for architectural or ornamental purposes and as a protection or shelter for window openings and to project the rain water a distance from the building. In a concrete building it has a structural duty; on the cantilever principal it helps to give the roof slab continuity, and it makes the cheapest method constructionally of finishing the top of a building.

The cost of a firewall and a staircase to get to the roof would be practical economy due to the great additional benefits to be derived from the use of the roof as above specified. In a hot country the roof, in most hours of the twenty-four, is the most livable part of the building, and any plan eliminating such use for the sake of the small saving to be made would be a matter of lasting regret.

Expansion Joints

The expansion joint is a longstanding bug-a-boo to a majority of concrete men in their different work, and I have been asked a number of times how I provided expansion joints in the roofs of the concrete buildings I erected. I can only answer that I did not provide any; I put the slabs on the buildings in one operation without any provision for expansion joints and have not had any trouble whatsoever.

A sidewalk man makes his unit slab between expansion joints anything from 3 ft. by the width of his strip to 30 ft. by the width of his strip. I make my unit slabs the size of the buliding. I have been able to find no rule as to the maximum size of a slab between expansion joints. There is none; I have made a slab 44′ x 60′ without an expansion joint and will possibly make them larger.

Roof Finish

There are any number of ways of finishing a concrete roof; each has its advantages and disadvantages; the best finishes are naturally the most expensive, and vice versa.

The cheapest roof and a good roof is the regular cement top dressing 1″ thick, colored to suit and with hydrated lime and waterproofing compounds to make it impervious to moisture. A good coat of paint adds to the value of this roof.

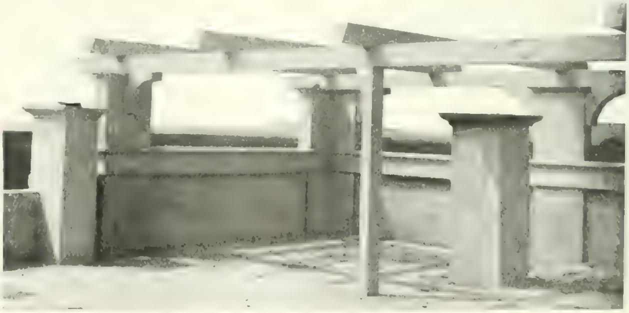

FIG. 2—A DETAILED CORNER OF THE FLAT ROOF

The great drawback with this cement top is that to insure a perfect bond the top should be put down as soon after the foundation slab is placed, as possible; the slabs should be grouted and the grout scratched in and then the top will never come away. This is not always convenient; in fact, it is usually very inconvenient and will not be followed to any considerable extent for that reason. A roof finish will be adopted that can be put down after the slab is set and the building well along to completion. This will naturally be some of the following types of composition roofs.

Composition roofs range from tar and paper and gravel, which is possibly the cheapest to buy but the poorest to walk on, to ordinary bitumen, then mastic, then magnesite and sanitary floorings to the different tiles and marble flags.

Mastic will probably be the future covering for concrete roofs. It is easy to apply after the building is finished, it is lasting, is satisfactory to walk upon, can be patched, and is the cheapest of the really serviceable composition roofs.

It costs possibly twice what a tar and gravel or a bitumen could be put down for, but is worth it. In the different tiles we have the ideal roof covering but the price makes such a roof prohibitive in any but the very elaborate buildings where cost is no object. The cheapest tile roof would cost five times more than the mastic, which puts it out of the question for ordinary work.

Tight roofs do not have to be graded, although a graded roof is always better than one that is dead flat. Water will always find its way off or evaporate, besides the roof is no place to stay when it is raining.

Casting Poles Vertically in a Rotary Mold

A patent was recently granted to A. M. Haymaker and J. P. Appleman, Pittsburgh, on a machine for the manufacture of reinforced concrete poles. The machine consists of a hollow inner tubing or mandrel which is rotatably supported on its lower end by a hollow spindle through which steam or hot water can be admitted. Reinforcing material for the concrete cylinder is placed outside the mandrel, after which the outer wall, or shell, is placed in position and connected so that it can be rotated in a direction opposite to the inner mandrel by the necessary gears or pinions.

The concrete is poured from the top. As this work progresses steam is turned into the inner mandrel to accelerate setting. This enables the operator to remove the finished column soon after the work of pouring the mixture has been completed. With one or both walls in motion as the filling goes on, the material is agitated within the mold and caused to settle. This fills all cavities.

Continuing the rotation of one or both shells [illegible] the walls of the concrete body a smooth finished surface and the heat drives off the moisture.

A Concrete Viaduct in the Northwest

(Staff Article)

FROM OCEAN TO OCEAN, at points of traffic concentration the low places are being spanned with great arched concrete viaducts, engineering structures of enduring beauty.

THE RECENTLY COMPLETED LATAH CREEK BRIDGE SPOKANE

A bridge which rivals any in the Northwest for architectural beauty has just been completed in the city of Spokane, Wn. The structure is 940′ long and its greatest depth from the ground level to the floor level is 139′.

It consists of seven arches of which two have 150-ft. spans, two with 135-ft. spans, one with 128-ft. span and two with 54-ft. spans. The bridge spans Latah creek and connects with the leading arterial approach from the extensive farming district west of the city. It is known as the Latah Creek bridge

It was opened for traffic October 1, the time occupied in construction being just two years. The contractor was J. C. Cunningham, Spokane. The bridge was designed and the construction was superintended under the direction of City Engr. Morton Macartney, Spokane. W. L. Malony made the design and it was checked by Messrs. Waddell & Harrington, Kansas City. J. F. Greene was the construction engineer.

The bridge replaces a timber trestle which because of the temporary nature of its construction had for years been a source of much annoyance to the public. The new bridge was located 55′ from the timber trestle, with its center line parallel to it, thus allowing the traffic over the trestle to continue until the new structure was completed. A 45-ft. roadway and two 7-ft. sidewalks make up the floor of the bridge and it carries a double track electric line.

The deck is carried upon a reinforced concrete floor consisting of a 9-in. slab carried by heavy transverse cross-beams spaced 5′ 6″ o. c. These beams were set directly on the spandrel walls. The slab is waterproofed with a mat of three alternate layers of burlap and asphalt. Above them are placed 2½″ of concrete and a 1-in. sand cushion for the 4-in.

creosoted wood blocks forming the paving.

Surface drains are provided at each pier and sub-drains leading into the main drains are supplied for the expansion joints. Ornamental cast-iron lighting posts, resting on the concrete rail, are placed at the piers on either side of the bridge.

Construction Notes

The concrete plant was located at the east end of the bridge and consisted of a storage bin for sand and dock and ½-yd. Smith mixer.[1] A cement[2] shed with a capacity of 2,000 bbls. was located on a railroad spur adjacent to the mixing plant. An industrial railway with turnouts and hoppers for depositing the concrete in the arches and piers was built along the south half of the trestle. Mechanical bond steel bars were used.[3]

Each of the arches consists of four ribs joined two and two by a 9-in. soffit wall, the sides of the ribs flaring with a vertical batter of 1 to 100. The piers are of the box type, with ribs connecting those of the adjacent arches. Curtain walls join the ribs of the pier together, and the projecting walls at both ends form bases for ornamental seats, on the deck.

Preliminary Work

Tests pits were sunk at the bridge site before the design was started, disclosing a bed of hardpan below the creek bottom and a compact sand at other points. As a result of loading tests upon the sand a maximum pressure of six tons to the sq. ft. was determined upon and heavy reinforced spread foundations were designed for the piers. In determining the span lengths for the arches, architectural considerations were given much weight and an effort was made to effect a combination which was adapted to the ground line and the site.

The intrado and the extrado curves are many centered and are so laid out as to give a neutral axis which conforms very closely with the thrust line of the arch under the dead load. The thickness of the arch is such that under any system of loads the line of resistance lies within the middle third and the maximum stress is below 500 lbs. per sq. in. Steel rods were placed in the concrete of the arch section to provide for temperature stresses. In the spandrel walls expansion joints concealed behind pilasters are provided at the end of each panel.

The arches were concreted with voussoir sections, eight to each pair of ribs, and three keys, one at the crown and one at each third point. Each of the two lower keys contained a 12-in. x 12-in. reinforced strut as a hinge.

Forms Used

The forms for the piers consisted of panels 5′ to 7′ high, with vertical sheeting made up of 2-in. x 10-in. tongue-and-groove material dressed to 1⅝″ and 3-in. x 8-in. horizontal waling spaced 4′ o. c. The walings were tied by "twisters" of ¼-in. galvanized wire spaced 4′ o. c., tightened against spreaders which were inserted between the forms and removed as the concreting progressed. The side forms on the arches were framed on the ground in panels with both the extrados and intrados cut to the required curvature. These were tied across the top with 2 x 8's, cleated to the lagging at the bottom and tied with galvanized wire at an intermediate level. The forms of the inner wall of the ribs were held up by temporary legs projecting down into the concrete, which were removed as the concreting progressed, the weight of the forms coming upon the 2-in. x 8-in. ties. The lagging for the extrados was nailed on the backs of the side forms.

The falsework consisted of 8-in. x 8-in. posts spaced about 14′ o. c. longitudinally and 5′ transversely. Upon these posts were placed corbels 3′ long, cut to the curve of the arch over which was built up a rib consisting of seven 1⅝-in. x 12-in. planks nailed and bolted with ⅝-in. bolts on 18-in. centers. In the process of concreting the crown sections of the arches were run first.

A comprehensive cost record of the job was kept by Mr. Greene, including a daily report embracing total quantities and costs for each individual portion of the work, and a monthly report, on which the totals for the month were drawn off. A diary was also kept which contains a daily report of accidents, discussions and disagreements, and other matters of interest. There was only one injury of a serious nature, an accident which necessitated the amputation of the leg of one workman.

The contract price for the bridge was $416,000, payable on the monthly basis, the city retaining 15% until the completion of the work.

Estimates and Time Schedules in Large Building Construction.

In a recent paper presented before the Cleveland Engrg. Soc. James I. Stuart, Contrg. Eng. Pittsburgh, discussed business methods in construction work. One of the essentials in successful construction brought out in Mr. Stuart's paper is that the engineer in charge of the work should anticipate each step in the progress of the building, and outline a complete system for its erection, including the various steps from the time the drawings are received from the engineer or architect until the completed building is turned over to the owner. The first step in such a process is to make a complete estimate of the cost of the structure from the drawings and specifications, including every item mentioned in the specifications or shown on the drawings. In addition to this there are other small items which are not mentioned in the specifications, but which are necessarily a part of the cost of the building and should be included as such. Under the latter are such items as the cost of administration, liability insurance, temporary buildings, expediting, tools and machinery and numerous smaller items.

After the estimate of the total cost of the building has been made—and an estimate should be made of every building, whether the work is to be let on a lump sum contract, cost plus a fixed sum, or on a time and material basis,—the next step is to make up a time schedule allowing fixed periods of time for the completion of each part of the building. This must be done most carefully, as on this schedule are based the dates of completion of the different contracts for material and the contracts with sub-contractors for furnishing such portions of the work as are not to be executed by the general contractor's force in the field. This time schedule is made after a thorough study of the drawings, the site of the new project and a familiarity with the estimate which give the quantities of the different kinds of material and assist in estimating the length of time required to complete the various stages of the work.

Concrete Steps for Railroad Embankment

The accompanying illustration shows the way the Long Island R. R. in the yards at Jamaica, L. I., is using concrete for steps to get from one track elevation to the other. Ordinarily, in a railroad yard or along a railroad embankment there is a straggling, slippery, insecure path, cutting diagonally up the embankment. These neat concrete steps are in striking contrast.

CONCRETE STEPS ON A RAILROAD EMBANKMENT

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[1] [illegible]

[2] Inland Portland Cement Co., Spokane

[3] Lackawanna Steel Co., Buffalo

Specifications for Drain Tile, for Sewer Tile and for Pipe Laying*

MANUFACTURERS OF PIPE AND TILE must obviate failure. To this end there is much of importance in Bulletin No. 31 from Iowa State College—particularly, in the chapter here published.

Article 54. Methods of Strengthening Drain Tile and Sewer Pipe to Carry Heavy Loads, by Bedding in Concrete. The many cases of cracking of drain tile and sewer pipe (tabulated in Table No. 1, pg. 24[1]) demonstrate that large drain tile and sewer pipe, as at present manufactured, are not strong enough to carry safely the weights of ditch filling which may come upon them in deep ditches.

A comparison of data[1] as to ordinary maximum loads on pipes in ditches, with data as to bearing strengths of drain tile and sewer pipe, will indicate clearly (when allowance is made for a proper factor of safety) just what sizes of ditches cause danger of cracking.

When it is found impossible, at reasonable cost, to obtain pipe strong enough to do away with the danger of cracking, reasonably strong pipe may be used, and strengthened by bedding in concrete.

Where the soil in which the ditch is dug is so solid and unyielding as to afford a good, safe support for the horizontal side thrust which would develop at the mid height of the pipe if it should crack, all that is necessary is to fill *completely* all the space between the tile and the bottom and sides of the ditch with very lean concrete, as shown in Fig. 1.

This method has been used with success in actual cases which have been reported to us.

When the soil is yielding, however, as in the case of muck, quick sand, soft loam, and the like, a good, strong concrete must be used, in sufficient thickness below the pipe, and at the mid height of the pipe, to furnish in itself a good, strong, broad foundation, together with side abutments at the mid height strong enough to carry safely the side thrust which would develop if the pipe cracked. This plan is shown in detail in Fig. 2.

We recommend applying the methods shown in these figures (Figs. 38 and 39 in the Bulletin) at all points on tile drains and sewer pipes where the bearing strengths of the pipe, as found by Iowa Standard tests (after deducting for the weights of the pipes themselves), are not at least 65% in excess of the ordinary maximum loads on pipes in ditches, as shown in Table No. 1 (Table No. 8 in the Bulletin, p. 46).

Article 55. Committees C4 and C6 of the American Soc. for Test. Mat. on Standard Specifications for Sewer Pipe and Drain Tile. The American Society for Testing Materials is widely recognized in the United States as the final authority for the preparation of standard specifications for the various materials of construction.

For several years the Society has had a regular committee, designated C4, at work on standard specifications for sewer pipe, but the committee has not yet made any definite recommendation of specifications.

Since 1911, the Society has also had a regular committee, designated C6, at work on standard specifications for drain tile, and an effort is being made to complete definite recommendations by June, 1914.

Iowa has one member of Committee C4, and four members of Committee C6.

When Committees C4 and C6 of the Am. Soc. for Test. Mat. complete their definite reports, and these have been adopted by the Society, their specifications will undoubtdly be accepted throughout the country as standard for drain tile and sewer pipe.

At present, however, drainage and sewerage engineers, and in fact all users and manufacturers of drain tile and sewer pipe, are in the greatest need of fair, definite and authoritative specifications for drain tile, for sewer pipe and for pipe laying.

Article 56. Recommended, Tentative, Standard Specifications for Drain Tile, for Sewer Pipe, and for Pipe Laying. To meet the imperative immediate need for definite specifications, until Committees C4 and C6 of the American Soc. for Test. Mat. can complete their reports, we recommend the use, for the present, by all drainage and sewerage engineers, of the following:

Tentative Standard Specifications for Drain Tile, for Sewer Pipe, and for Pipe Laying[2]

A. Marston, Ames, Ia.; Seth Dean,

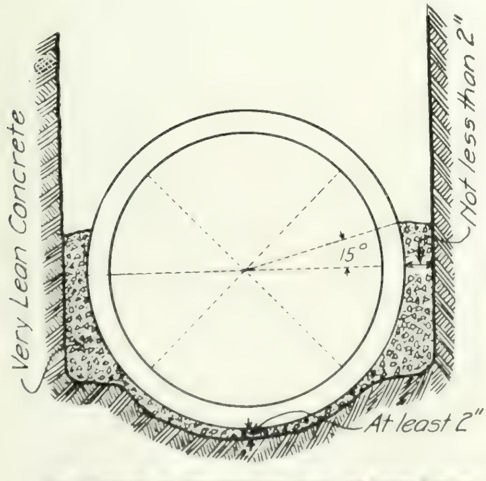

Fig. 1—Method of Strengthening Drain and Sewer Pipe to Carry Heavy Loads, by Bedding in Concrete, in Solid Soils

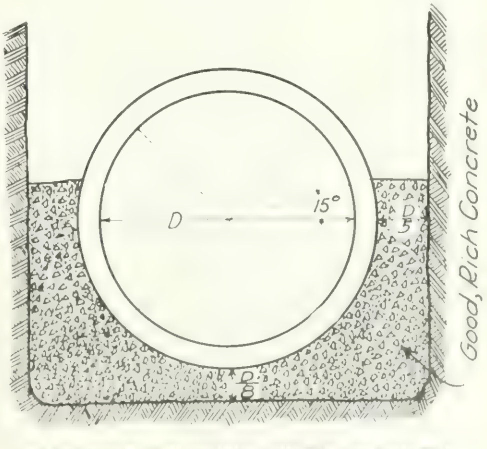

Fig. 2—Method of Strengthening Drain Tile and Sewer Pipe to Carry Heavy Loads, by Bedding in Concrete, in Yielding Soils

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*From Bulletin No. 31, Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts, Ames, Ia.: "The Theory of Loads on Pipes and Ditches, and Tests of Cement and Clay Drain Tile and Sewer Pipe," by A. Marston and A. O. Adams

[1] This chapter is from a book of 181 pages, and for tables and other data mentioned as included in the work reference is made to the Bulletin—EDITORS

[2] Officially adopted by the Iowa State Drainage Association at its Fort Dodge Meeting, Feb. 19, 1913

Glenwood, Ia.; and W. B. Warrington, Pocahontas, Ia., committee.

1. *Engineer to Make all Tests.* All tests of drain tile and sewer pipe shall be made by the engineer and his assistants.

2. *Selection of Pipe For Tests.* All drain tile and sewer pipe for tests shall be carefully selected by the engineer, to represent fairly the quality of the pipe, from the stock furnished by the contractor for use on the job.

3. *Payment of Costs of Tests.* All costs of tests of drain tile and sewer pipe, except the cost of the pipe tested, shall be paid by the employer of the engineer. The personal services of the engineer and his assistants shall be paid for at the same rates allowed them for other regular work.

4. *Contractor to Supply Test Pipe Free.* The contractor shall supply all drain tile and sewer pipe required for tests, free of charge, delivered at the testing machine, which, for this work will be located at ....

Ordinarily, not more than ½ of 1% of the pipe supplied will be tested, but in any case at least five pipe shall be supplied, and in case the first test shows marked irregularities, or other important peculiarities of pipe, the engineer may require pipe for a second set of tests.

5. *Method of Testing.* All tests shall be made strictly in accordance with the Iowa Standard Specifications for Testing Drain Tile and Sewer Pipe, as given on pgs. 97 to 99 of Bulletin No. 31, of the Iowa Engineering Experiment station.

6. *Maximum Allowable % Absorption for Drain Tile and Sewer Pipe.* The maximum allowable % of absorption for drain tile and sewer pipe shall be as follows:

For Cement Drain Tile .. % max. allowable average absorption.

For Clay Drain Tile .. % max. allowable average absorption.

For Cement Sewer Pipe .. % max. allowable average absorption.

For Clay Sewer Pipe .. % max. allowable average absorption.

Note.—Where the engineer does not have better data of the good pipe available in his locality, we recommend that the absorption % inserted above be between the following limits:

For Cement Drain Tile, 6.5% to 9%.

For Clay Drain Tile, 6% to 7%.

For Cement Sewer Pipe, no data available.

For Clay Sewer Pipe, 4% to 5%.

7. *The Ordinary Maximum Loads on Drain Tile and Sewer Pipe in Ditches.* The ordinary maximum loads on drain tile and sewer pipe in ditches, from common ditch filling materials, shall be considered to be as follows, in lbs. per lin. ft. of pipe:

8. *The Minimum Allowable Bearing Strengths of Drain Tile and Sewer Pipe.* No drain tile or sewer pipe not strengthened by bedding in concrete shall be used in any part of a ditch where the average bearing strength of the pipe, as determined by the Iowa Standard Tests (See Clause 5, above), is not equal, in addition to the weights of the pipe themselves, to at least 165% of the ordinary maximum loads on pipes in ditches (as specified in Clause 7 above).

Drain tile and sewer pipe of less bearing strength than required in the above paragraph shall, if used, be strengthened by bedding in concrete, as provided in clauses 13 and 14, below, at the expense of the pipe contractor (with exception as provided in clause 14), who shall have the option of paying for such strengthening or of furnishing pipe strong enough to give the safety factor of 1.65 as required above.

The engineer shall furnish each bidder convenient access, in ample time before the receipt of bids, to an accurate profile showing the depths of pipe at all points of the sewer or drain, and to clear specifications as to width of trench at level of pipe, so that the exact lengths of extra strong pipe or strengthening by bedding in concrete can readily be ascertained in advance.

The pipe laying contractor shall be responsible for all increased costs for extra strong pipe or bedding in concrete required by wider trenches at the level of the pipe than specified in advance by the engineer, and the county (city) shall deduct therefor from his payments, and pay said deductions to the pipe contractor.

No drain tile or sewer pipe shall be used in any case whose average bearing strength, as determined by Iowa Standard Tests (See Clause 5, above), is less than specified in the following table:

Internal Diameter	Minimum Allowable Average Bearing Strengths per lin. ft.	per lin. ft.
Less than 15″	1,000 lbs.	1,250 lbs.
15″ to 20″	1,250 lbs.	1,500 lbs.
21″ to 27″	1,500 lbs.	1,900 lbs.
28″ to 36″	1,850 lbs.	2,400 lbs.

9. *General Requirements as to the Quality of Drain Tile.* All drain tile shall be good, sound tile, of first class quality. They shall be entirely free from cracks and fire checks extending into the body of the pipe in such a way as appreciably to lower its strength. No pipe shall be accepted having pieces broken out in such a way or to such an extent as appreciably to affect the strength of the pipe, or to permit the entrance of soil into the drain.

The pipe shells shall have uniform, strong, dense structures throughout, without serious flaws or weak spots.

All pipe shall have a clear ring, when stood on end or laid on one side, evenly supported at the lower end, or along a line of one side, and free elsewhere, and tapped with a light hammer while dry.

All pipe shall be regular and true in shape. The average diameter shall not be more than 2% less than the specified diameter. No two diameters

TABLE I

APPROXIMATE ORDINARY MAXIMUM LOADS ON DRAIN TILE AND SEWER PIPE IN DITCHES FROM COMMON DITCH FILLING MATERIALS IN POUNDS PER LINEAR FT

Height of Fill Above Top of Pipe	Breadth of Ditch, at Top of Pipe									
	1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.	1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.
	Partly Compacted Damp Top Soil 90 Lbs. per Cu. Ft.					Saturated Top Soil 110 Lbs. per Cu. Ft.				
2 Feet	[illegible]	310	490	670	830	170	380	600	820	[illegible]
4	[illegible]	[illegible]	[illegible]	1230	1580	[illegible]	670	1090	[illegible]	1950
6	230	690	[illegible]	[illegible]	[illegible]	[illegible]	870	1500	2140	2780
8 "	[illegible]	[illegible]	1430	[illegible]	2790	340	1030	1830	[illegible]	3510
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1150	2100	3120	[illegible]
	Dry Sand 100 Lbs. per Cu. Ft.					Saturated Sand 120 Lbs. per Cu. Ft.				
2 Feet	150	340	550	710	[illegible]	180	[illegible]	650	890	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	1750	270	710	[illegible]	1640	[illegible]
6	[illegible]	[illegible]	1320	[illegible]	[illegible]	[illegible]	[illegible]	1590	2270	2970
8	[illegible]	890	[illegible]	[illegible]	3100	340	1070	1910	2820	3720
10 "	[illegible]	[illegible]	[illegible]	2720	3650	350	[illegible]	2180	3260	[illegible]
12	[illegible]	1040	2000	[illegible]	[illegible]	360	1250	[illegible]	[illegible]	[illegible]
14	300	1090	2140	[illegible]	[illegible]	360	1310	[illegible]	3990	[illegible]
16	300	1130	[illegible]	[illegible]	4950	[illegible]	1350	2710	[illegible]	5910
18	300	[illegible]	[illegible]	3740	[illegible]	360	[illegible]	2820	[illegible]	6330
20	300	[illegible]	2420	3920	[illegible]	360	1400	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	5800	360	[illegible]	2980	4880	[illegible]
24	[illegible]	1190	2540	[illegible]	6030	360	[illegible]	3050	5010	7230
26	300	[illegible]	[illegible]	[illegible]	6210	360	1440	3090	5150	[illegible]
28	300	[illegible]	[illegible]	4370	[illegible]	360	1440	3120	5240	[illegible]
30 "	300	[illegible]	[illegible]	[illegible]	6530	360	1410	[illegible]	[illegible]	[illegible]
Infinity	300	1210	2730	[illegible]	7580	360	[illegible]	3270	5820	9090
	Partly Compacted Damp Yellow Clay 100 Lbs. per Cu. Ft.					Saturated Yellow Clay 130 Lbs. per Cu. Ft.				
2 Feet	160	350	[illegible]	750	930	210	[illegible]	730	1000	1240
4	250	620	1010	[illegible]	1800	340	840	1330	1870	[illegible]
6 "	300	830	1400	1990	2580	430	1140	1900	2630	3410
8 "	330	[illegible]	1720	2500	[illegible]	490	1380	[illegible]	3360	4400
10	350	1110	2000	2920	[illegible]	[illegible]	1570	2760	[illegible]	5270
12 "	360	1200	[illegible]	[illegible]	4450	[illegible]	1730	3100	4560	[illegible]
14	370	1280	[illegible]	3650	[illegible]	560	1850	[illegible]	5050	6760
16	370	[illegible]	2570	3950	[illegible]	[illegible]	1910	[illegible]	[illegible]	7440
18 "	380	[illegible]	2710	[illegible]	5810	570	[illegible]	[illegible]	[illegible]	8060
20	[illegible]	1410	2830	4450	[illegible]	580	2090	4070	6280	8610
22	380	[illegible]	[illegible]	[illegible]	6500	[illegible]	2140	4210	[illegible]	9130
24	[illegible]	1450	3000	[illegible]	6800	580	2180	4380	[illegible]	9590
26 "	380	1470	[illegible]	4980	7080	[illegible]	[illegible]	4500	[illegible]	10010
28	380	1480	3120	5100	7310	580	[illegible]	[illegible]	[illegible]	10430
30 "	380	1490	3170	5230	7530	580	[illegible]	[illegible]	[illegible]	10780
Infinity	[illegible]	1520	3410	6060	[illegible]	580	[illegible]	5270	[illegible]	[illegible]

of the same pipe shall differ from each other more than 7%, nor shall the average diameters of adjacent pipe differ more than 4%.

Pipe may be furnished in lengths of 1′, 2′, 2′ 6″, and 3′, but 1-ft. lengths shall not be used for sizes over 15″ in diameter. No pipe, designed to be straight, shall vary from a straight line more than 1½% of its length.

If cement tile are used, they shall show a uniform, dense structure, with clean aggregates, well graded as to size of materials, and with the grains and pieces of aggregate well coated and the pores well filled with good Portland cement. There shall be no spots of specially great porosity. Fractured surfaces shall show broken pieces of aggregate, firmly bedded in the concrete. The general appearance of the material shall be at least equal to that of first class gravel concrete, in proportions: 1 first class Portland cement; to 2 clean, coarse sand; to 1 pebbles, ⅛″ to ½ thickness of tile wall in size.

10. *General Requirements as to the Quality of Sewer Pipe.* All sewer pipe shall be of the hub and spigot pattern, unless special permission be given to use other forms of joints. Bells shall be of sizes which will leave an annular space for cement at least ⅜″ thick for 10-in. pipe and smaller, and ½″ for larger sizes. Standard depths of sockets shall be used.

All sewer pipe shall be of first class quality. They shall be entirely free from cracks and fire checks extending into the body of the pipe in such a way as appreciably to lower its strength. No pipe shall be accepted having pieces broken out in such a way or to such an extent as appreciably to lower the strength.

The pipe shells shall be of uniform, strong, dense structure, throughout, without serious flaws or weak spots.

All sewer pipe shall give a clear ring, when stood on end or laid on one side, evenly supported at the lower end or along a line of one side, and free elsewhere, and tapped while dry with a light hammer.

All sewer pipe shall be regular and true in shape. The average diameter shall not be more than 2% less than the specified diameter. No two diameters of the same pipe shall differ more than 5%. Pipe which are to join in the ditch shall be fitted at the surface before lowering, and shall match truly, with ample room for cement joint.

Sewer pipe may be furnished in lengths of 2′, 2′ 6″ or 3′. No pipe, designed to be straight, shall vary from a straight line more than 1% of its length.

If clay sewer pipe are used, they shall be the best, vitrified, salt-glazed pipe. Any pipe which betrays in any manner a want of thorough vitrification or fusion, or the use of improper materials or methods in its manufacture, shall be rejected. All pipe shall be smooth and well glazed on the inside, and free from broken blisters, lumps or flakes which are thicker than 15% of the nominal thickness of the pipe, or whose largest diameters are greater than 10% of the inner diameter of the pipe; and all pipe having broken blisters, lumps or flakes of any size shall be rejected unless the pipe can be so laid as to bring all these defects in the top half of the sewer. No pipe shall be used having any of the above defects, unless they will not appreciably weaken the pipe, as laid in the ditch.

Table II

FOR CLAY, AND ALL COMMON SOILS, OR COMBINATIONS OF SOILS EXCEPT SAND AND LOAM

Height of Fill Above Top of Pipe	Breadth of Ditch at Top of Pipe				
	1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.
2 ft.	210	470	730	1000	1240
4 ft.	340	840	1330	1870	2370
6 ft.	430	1140	1900	2630	3410
8 ft	490	1380	2360	3360	4400
10 ft	520	1570	2760	3980	5270
12 ft.	540	1730	3100	4560	6050
16 ft.	570	1940	3660	5510	7440
20 ft.	580	2090	4070	6280	8610
24 ft.	580	2180	4450	6910	9590
30 ft.	580	2260	4700	7590	10780

FOR SAND AND LOAM, UNMIXED WITH OTHER SOILS

Height of Fill Above Top of Pipe	1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.
2 ft.	180	410	650	890	1110
4 ft.	270	710	1170	1640	2100
6 ft.	310	910	1590	2270	2970
8 ft.	340	1070	1910	2820	3720
10 ft.	350	1180	2180	3260	4380
12 ft.	360	1250	2400	3650	4980
16 ft.	360	1350	2710	4260	5940
20 ft.	360	1400	2910	4700	6660
24 ft.	360	1430	3050	5010	7230
30 ft.	360	1440	3150	5340	7830

NOTE.—For dimensions of ditch not given the loads shall be interpolated between the loads in the table.

If cement sewer pipe are used, they shall show a uniform, dense structure, with clean aggregates, well proportioned as to size of materials, and with the grains and pieces of aggregate well coated and the pores well filled with good Portland cement. There shall be no spots of specially great porosity. Fractured surfaces shall show broken pieces of aggregate, firmly bedded in the concrete. The general appearance of the material shall be at least equal to that of first class gravel concrete, of proportions: 1 part of first class Portland cement; to 1 of clean, coarse, graded sand; to 1 or 2 pebbles, ⅛″ to ½ thickness of sewer pipe walls in size. All pipe shall have very smooth and impervious inside surfaces, entirely free from patching with cement.

11. *Field Inspection of Drain Tile and Sewer Pipe.* The engineer shall very carefully inspect all drain tile and sewer pipe, as actually delivered along the ditch for use. He will cull out and mark for rejection all poor pipe, and pipe so rejected shall be promptly removed by the contractor.

12. *Ordinary Pipe Laying.* All pipe laying in ordinary soils, not requiring special foundations, in which strengthening by bedding in concrete is not required by clauses 8 above and 13 and 14, below, is hereby designated "ordinary pipe laying."

In all "ordinary pipe laying" in hard soils, the contractor shall shape the bottom of the ditch approximately to fit the lowest 90° (45° each side the center line) of the circumference of the pipe, taking pains to secure an extra firm bearing near the outer edges of the 90° strip. Upon the concave surface so prepared the contractor shall spread a layer, 1″ to 2″ thick, of pulverized soil, or sand free from pebbles larger than ¼″ diameter, and shall firmly bed each pipe truly to line and grade thereon.

Where the bottom of the ditch is so wet and soft as to enable the thorough bedding of the lowest 90° of the pipe without the use of the layer of pulverized earth or sand, and still is firm enough to afford good, safe support to the pipe and its load of ditch filling, the engineer may authorize the omission of the layer of granular material, but such authorization shall not excuse imperfections of bedding of the lowest 90° of the pipe circumference.

The space between the pipe and the bottom and sides of the ditch shall be *completely* packed *full*, by hand with selected earth, and tamped with a light tamper as fast as placed, all up to the level of the top of the pipe. The side filling shall be carried up as fast on one side of the pipe as on the other.

The pipe shall then be covered by hand, with selected earth to a depth of at least 18″ above the top of the pipe.

Wherever the factor of safety of the pipe, as calculated from the test strength and the loads in clause 7, above, exceeds 2.5, the shaping of the bottom of the ditch to fit more than 45° of the bottom of the pipe may be omitted, together with the bedding in a layer of granular material, and the special tamping of the side filling around the pipe.

13. *Strengthening Drain Tile and Sewer Pipe to Carry Heavy Loads by Bedding In Concrete, In Solid Soils.* In all parts of ditches in solid soils where clause 8, above, requires the pipe to be strengthened to carry heavy loads by bedding in concrete, the work shall be done as follows:

The bottom of the ditch shall be shaped by the contractor to fit approximately the lowest 90° (45° each side of the center line) of the pipe circumference. Upon the concave surface so prepared the contractor shall spread a layer of at least 2″ of soft concrete, still enough to sustain the weight of the pipe, and the pipe shall be firmly bedded truly to line and grade in this concrete.

The space between the pipe and the bottom and sides of the ditch shall then be completely packed full of soft concrete, up to a level 15° of the pipe circumference above the mid-height. The thickness of the concrete shall not at any point be less than 2". It shall be tamped in place with a light tamper.

Care shall be taken to prevent the entrance of the concrete to the interior of the pipe through the joints, and each joint shall be promptly cleaned on the inside of the pipe, before the concrete has had time to set.

The concrete used in this method of strengthening pipe shall be made of 1 part of Portland cement to 8 parts of gravel, or 1 Portland cement to 5 sand to 8 broken stone. No pebbles or stone shall exceed in size ½" less than the thickness of the concrete.

The above type of construction shall be adopted at such points on the ditch as required by clauses 7 and 8, above, where the soil is as solid as average firm clay sub-soil, and the contractor shall be paid therefor at the prices bid by him per linear foot for different diameters of pipe, for "Bedding Pipe in Concrete in Solid Soils," for which item the engineer shall insert suitable blanks in his "form for proposals." Payment shall be made by the county (city), but will be deducted from the payments to the pipe contractor for pipe.

14. *Strengthening Drain Tile and Sewer Pipe to Carry Heavy Loads, By Bedding In Concrete, In Yielding Soils.* In all parts of ditches in yielding soils (such as muck, quicksand, etc.), where clauses 7 and 8, above, require the pipe to be strengthened to carry heavy loads by bedding in concrete, the work shall be done as follows:

The bottom of the ditch shall be finished approximately level, with slightly rounded corners, and on this shall be spread a layer of soft concrete the full width of the ditch, on which the pipe shall be firmly bedded truly to line and grade. The thickness of concrete below the lowest part of the body of the pipe shall be at least ⅛ the inside diameter.

Soft concrete shall then be built up on each side of the pipe, completely filling all the space under and up to it, up to a level on each side of the pipe about 15° of the pipe circumference above the mid height. The width of the concrete shall be such as to give a thickness on each side of the pipe at its mid height of at least 1/5 the inside diameter. The concrete shall be tamped with a light tamper.

Care must be taken to prevent the entrance of the concrete to the interior of the pipe through the joints, and each joint shall be promptly cleaned on the inside before the concrete has had time to set.

The concrete used in this method of strengthening pipe shall be made of 1 part of standard Portland cement to 5 parts of good, coarse, clean gravel, or 1 standard Portland cement to 3 clean, coarse sa[illegible] pebbles or stone shall exceed 2½" in greatest diameter.

The above type of construction shall be adopted at such points on the ditch as the engineer may direct, and the contractor shall be paid therefor at the prices bid by him per linear foot for different diameters of pipe, for "Bedding Pipe in Concrete in Yielding Soils," for which item the engineer shall insert suitable blanks in his "form for proposals." Such payment shall be made by the county (city), and partial deduction therefor shall be made from the payments to the pipe contractor for pipe, but only to the extent of the prices in the pipe laying contract for "Bedding Pipe in Concrete in Solid Soils," as specified in clause 13, above.

15. *Protection of Drain Tile and Sewer Pipe From Injury In the Ditch From Freezing.* No drain tile or sewer pipe shall be exposed to freezing in a ditch, during construction, with less than 2' of ditch filling cover over its top.

Some Data on Reinforcing Concrete Pipe

BY CHARLES E. SIMS*

After a consideration of the specifications arrived at by A. Marston and A. O. Adams for drain tile, sewer pipe and pipe laying elsewhere in this issue data supplied by Mr. Sims on means of avoiding cracking of pipe in ditches are particularly valuable. Mr. Sims's discussion is informal, having come to CONCRETE-CEMENT AGE *in the form of copies of letters written by Mr. Sims in answering inquiry.*

In regard to the value of reinforcing in tile, I do not feel that my own tests have been enough to warrant conclusions as definite as is desirable. In making the tests it should be known that the method employed in loading the specimens was to place the tile on a plank lengthwise, then to place another plank on the top of the tile lengthwise with planks crosswise to form a platform. Care was taken to keep the load balanced on the tile as the sacks of cement were applied, but we supported one end of the planks as was required to keep the platform from tipping. While the method is crude, it appeared to be fairly satisfactory. Should the results obtained be compared with the Ames method of testing, I believe the loads applied should be multiplied by the factor 1.5; and should it be desired to compare tile 6 das. old with tile 28 das. old it must be remembered that at ordinary summer temperatures of 60° to 70° the compressive strength of concrete increases in that time about 70% and the tensile strength 70%, and the latter is the governing condition, since tile begin to fail by tension of the concrete. For comparing tile 16 das. or 18 das. old with tile 28 das. old the tensile strength should be increased about 30%.

Theory of Reinforcement of Tile

The fact that concrete is stronger in compression than in tension makes reinforcement against failure from tension necessary, as a matter of economy. Concrete tile fail by cracking longitudinally along the top, bottom and sides of the tile. As the cracks appear one can notice that the concrete is pulled apart, that is, fails from tension, on the inside of the tile at top and bottom of the tile and at the outside of the tile at the sides of the tile. Accordingly the steel reinforcement should be placed as close to the sides of the tile as possible, to accomplish which would require an elliptical form of hoop, or, at twice the expense for metal, a pair of circular hoops, one near the inner surface and one near the outer surface of the wall of the tile. The writer favors the double hoops because it is impossible to tell from what direction the load may come in the ditch upon the tile, even if it were possible to tell that the tile would be bedded right side up as intended.

The first tests on the 18-in. tile were made to determine whether or not a single hoop in the center of the tile would materially increase the strength of the tile; theoretically, it would have little value, since the concrete could crack half through the tile wall before the metal would begin to act appreciably. Tests show apparently that the introduction of single hoops add little to the strength and are scarcely worth while. The greater strength of No. 3 is probably accounted for by the different sand and the higher temperature the tile was kept in.

The tests on the 30-in. tile were made to determine the value of the different types and amounts of reinforcing. The tests will be carried further to determine what is the strength of an unreinforced 3-in. wall 30-in. tile compared to the reinforced 2½-in. wall. Note the kinds of reinforcing and again the evidence from specimens 4, 5 and 7 that reinforcement in the center of the tile wall has little value. Specimen No. 6 was made to determine whether or not longitudinal bars in the tile, such as are sometimes used for culvert tile, where their use is to hook together to tie the tile end to end, would weaken the tile. One would expect such to be the case and the results confirm the expectations. There can be no use of longitudinal reinforcement in tile of comparatively short lengths as ordinarily made for drainage use, for tile break longitudinally, not roundways, when they do break.

Formula for Reinforcement

From theory and from observation of the failures of test specimens we learn that the greatest strain on the wall of a tile from a load applied along a line at the top and bottom of the tile is at the crown or inside surface of the tile at the top, and an equal strain at the inside at bottom of the tile; hence the reinforcement desired to meet this condition will suffice anywhere else in the tile. Of course, if a tile is tamped in place at the sides the tile will withstand a far greater load than when the sides are free to spread—the action being the same as an arch. We are considering here that the sides of the tile are not supported by tamped earth, since it is difficult to get the tamping done in practice and a question whether it is not better to make our tile strong enough anyway. If, then, M = the negative bending moment at the crown, or inside of top of tile, W is the weight in lbs. per in. in length of tile—weight being applied along a line longitudinally at top of tile—and D is the diameter of tile center of wall to center of opposite wall, by the Bulletin 22, University of Illinois.

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$M = .091WD$ and if the load is applied top and bottom of tile without concentration the formula is $M = .0625WD$—probably .075 fairly represents average ditch loads. Applying this formula last given: Suppose we have a 30-in. tile, not reinforced, 2½-in. wall. Assume a good concrete, 28 das. old, sufficiently dense to be little affected in strength by moisture in the earth, so that the tensile strength of the concrete may be taken as 400 lbs. per sq. in. If $M = .075WD$ and W is taken for a foot length of tile and if we consider that the force of M acts on an area of .8 inch (⅓ wall thickness, a crude approximation) depth taken longitudinally, then to find what load the tile will support we may substitute the values in the formula as follows:

$$M = 400 \times .8 \times 12 = .075W32.5$$

$$\text{or } W = \frac{M}{.075D}$$

$$3840 = 2.44W \text{ or } W = 1574$$

This result shows that a 30-in. tile of good concrete, 1/12 wall thickness, may stand a ditch load of 1.580 lbs. per foot length of tile, or it might be expected to crack when in a ditch with three feet of fill.

The above values in the formula must be checked by test, especially as 400 lbs. tension is a high value.

RESULTS OF TILE TESTS

NUMBER	AGE DAYS	SIZE OF TILE	DESCRIPTION OF REINFORCING	LOAD TO FIRST CRACK	LOAD TO COMPLETE FAILURE
1	6	18"	6 hoops No. 12 wire in center of tile wall	1,055	1,055
2	6	18"	2 hoops No. 12 wire in center of tile wall	1,150	1,150
3	6	18"	No reinforcing	1,530	
4	16	30"	7 pairs No. 7 wire hoops	[illegible]	[illegible]
5	16	30"	5 pairs No. 7 wire hoops	2,285	test not complete
6	16	30"	3 [illegible] bars [illegible] at third points and square mesh wire fencing at center of wall	1,335	1,635
7	[illegible]	30"	Square mesh wire fencing at center of wall	1,635	1,635

Notice how much stronger the specimens No. 4 and No. 5 were, due to hoop reinforcing.

No. 1 and No. 2 were of lake sand, that had few stones, machine-made and set on work room floor, where temperature averaged 50°, until day of test. Tile failed suddenly, showing no broken stones.

No. 3 was of bank sand well graded, machine-made and placed in curing room, where temperature averaged 70°, until day of test. Tile failed suddenly.

No. 4 and No. 5 were of bank sand well graded, hand tamped and placed on work room floor, where temperature averaged 50°, until day of test. First cracks appeared longitudinally on the inside at the top and bottom and on the outside at sides.

No. 6 was of bank sand well graded, hand-tamped and placed on work room floor, where temperature averaged 50°, until day of test. The top and bottom horizontal wires of the reinforcing were No. 9, the intermediate horizontal and cross wires were No. 12. The first cracks appeared along the bars and then at the bottom. At complete failure the wires pulled in two, but concrete did not crush.

No. 7 was of bank sand well graded, machine-tamped and placed on work room floor, where temperature averaged 50°, until day of test. Wire fencing was same as in No. 6. Tile cracked in quarters and failed suddenly. Wires pulled in two and concrete did not crush.

Note.—Mixture in all tile was very wet.

All tests were conducted with concentrated load applied to tile, by placing a plank lengthwise along the top of tile which supported a platform on which load was placed.

As to the formula for determining the relative value of reinforcement in tile, we have worked this formula out for comparison, applying it to a 30-in. diameter tile. I believe this formula can safely be used for any size tile.

It will be noticed that a 30-in. tile 1/12th wall thickness reinforced with four pairs of No. 1 wire hoops has approximately the same strength as a 30-in. tile 1/10th wall, not reinforced. To determine which of the two would be the more economical the cost of the material in the additional concrete required for the 1/10th wall plus the additional freight and cost of hauling as compared to the cost of the reinforcing wire and placing it in the concrete in the 1/12th wall tile should be considered.

The Formula

Use of the formula is exemplified as follows. Compare the results of various amounts of reinforcing.

30-in. diameter tile, 1/12th wall thickness, not reinforced. Tile 30" long.

$$W = \frac{M}{.075D} \text{ or } W = \frac{30 \times .8 \times 400}{.075 \times 32.5} = \frac{9{,}600}{2.44} =$$

3,934 lbs. per tile.

3934÷2½=1,574 lbs. per ft. length of tile.

30-in. diameter tile, 1/12th wall thickness, reinforced with one pair of No. 7 wire hoops. Tile 30" long.

$$W = \frac{M}{.075D} \text{ or } W = \frac{(30 \times .8 \times 400) \text{ plus } .025 \times 20{,}000}{.075 \times 32.5}$$

$$\frac{9{,}600 \text{ plus } 500}{2.44} = 4{,}140 \text{ lbs.}$$

4140÷2½=1,656 lbs. per ft. length of tile.

30-in. diameter tile, 1/12th wall thickness, reinforced with two pairs of No. 7 wire hoops. Tile 30" long.

$$W = \frac{M}{.075D} \text{ or } W = \frac{(30 \times .8 \times 400) \text{ plus } 2 \times (.025 \times 20{,}000)}{.075 \times 32.5}$$

$$\frac{9{,}600 \text{ plus } 1{,}000}{2.44} = 4{,}303 \text{ lbs.}$$

4303÷2½=1,720 lbs. per ft. length of tile.

30-in. diameter tile, 1/12th wall thickness, reinforced with three pairs of No. 7 wire hoops. Tile 30" long.

$$W = \frac{M}{.075D} \text{ or } W = \frac{(30 \times .8 \times 400) \text{ plus } 3 \times (.025 \times 20{,}000)}{.075 \times 32.5} =$$

$$\frac{9{,}600 \text{ plus } 1{,}500}{2.44} = 4{,}550 \text{ lbs.}$$

4550÷2½=1,820 lbs. per ft.

30-in. diameter tile, 1/12th wall thickness, reinforced with four Pairs of No. 7 wire hoops. Tile 30" long.

$$W = \frac{M}{.075D} \text{ or } W = \frac{(30 \times .8 \times 400) \text{ plus } 4 \times (.025 \times 20{,}000)}{.075 \times 32.5} =$$

$$\frac{9{,}600 \text{ plus } 2{,}000}{2.44} = 4{,}754 \text{ lbs.}$$

4754÷2½=1,900 lbs. per ft.

30-in. diameter tile, 1/10th wall thickness, not reinforced. Tile 30" long.

$$W = \frac{M}{.075D} \text{ or } W = \frac{30 \times 1 \times 400}{.075 \times 33} = \frac{12{,}000}{2.48} =$$

4,840 lbs. per tile.

4840÷2½=1,940 lbs. per ft.

30-in. diameter tile, 1/10th wall thickness, reinforced with four pairs of No. 7 wire hoops. Tile 30" long.

$$W = \frac{M}{.075D} \text{ or } W = \frac{(30 \times 1 \times 400) \text{ plus } 4 \times (.025 \times 20{,}000)}{.075 \times 33}$$

$$\frac{12{,}000 \text{ plus } 2{,}000}{2.48} = 5{,}645 \text{ lbs.}$$

5645÷2½=2,258 lbs. per ft.

Pit Silos in the Southwest

IN DRY LOCALITIES a circular semi-spherical bottomed pit lined with cement mortar, and rimmed with a heavy concrete collar, can be used for silage. In the Southwest, such structures are paving the way for silos by educating farmers in the use of silage. These pits might better be called "elementary silos."

Cement plaster is being put to a new use in the Southwest. Out in what is known as the dry farming country, where agriculture, to be successful, must be carried on scientifically, through conservation of moisture and proper saving of every bit of fodder, resourceful farmers are applying modern means to an old principle in the preservation of feed for their livestock. In the days of Roman agriculture, to which the discovery of silos is ascribed, the silo was a pit in the ground into which the whole green fodder was piled, so that when the top was properly sealed with straw and dirt, it remained airtight. The ancient pit silos were of rectangular construction.

To suit this type of silo to modern conditions the pit is dug in circular form and its walls are then covered with two or three coats of cement plaster, thus making it to some extent a permanent structure.

Pit Silos for Dry Territory Only

This type of silo is practical only in a country that is not troubled with surface water and one that has a sufficiently compact soil to make smooth, dependable walls for the cement plaster coating. Without a proper cement mixture, one season's use would be the entire life of such a silo, as the walls would cave in after the silage was removed. To be successful they are built like a cistern, with a collar at the top of sufficient strength to support a roof and the rigging for raising the silage.

The Agricultural Dept. of the Rock Island Lines, under direction of Prof. H. M. Cottrell, recently conducted a silo campaign by running an educational train over that company's lines in Kansas, eastern Colorado, northeast New Mexico, Oklahoma and portions of Texas. This train carried models of all makes of silos, from the "hole in the ground" to the highest type of concrete silo. The pit was shown by a good sized model encased in dirt, held in a wooden frame. Farmers, apparently, took more interest in the pit silo than in any of the other models, because of its uniqueness, as well as the economy of construction.

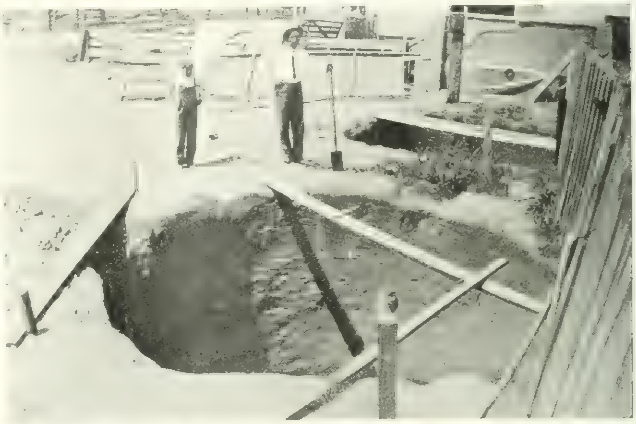


Fig. 1—Three Pit Silos of 60-ton, 80-ton, and 100-ton Capacities Being Dug on Farm of C. O. Davis at Liberal, Kans.

Economy of Pit Silos

They were advised, however, that the pit silo was a makeshift, to be resorted to only where the soil and water conditions were suitable and the farmers felt unable to erect a better type of silo. Many silos of this type have been built in Seward county, Kans., around the town of Liberal, which is a great broom corn shipping center. Broom corn is the chief cash crop in that section, but farmers have, through construction of pit silos, been enabled to make dairying very profitable. Before the advent of the silo, dairy cows were expected to maintain a milk flow on dry buffalo grass pasture and corn, or Kafir stalks with a little grain feed. The results were not good. Since silos have been built, farmers have been able to keep their cows in fine milking condition through the winter months by feeding Kafir or Milo maize heads for grain, with silage.

These same farmers have, also, been the first to try broom corn stalks as silage, and their experiments in this line have proven successful.

Community labor has enabled them to build their silos at a cost of about $25 each and, by combining in the purchase of a cutter, which costs anywhere from $125 to $300, according to size, the problem of putting up green feed for winter use has been economically solved. Most of the silos of this type built in southwest Kansas are 20′ to 25′ in depth and 15′ in diameter, making the capacity about 75 tons. This quantity of green, succulent feed keeps the milk flow up to standard during the months when the pasture is dry and, consequently, there is no cessation in the farm income in winter. Most of these farmers, if they had been obliged to wait until they had sufficient cash to put up a high silo, at a cost of $200 to $300, would still be waiting. With the aid of the pit silo they are laying by something, and when the pit has served its usefulness, they will be financially able to build above ground, should they decide to do away with the inconveniences that attend the pit type of construction.

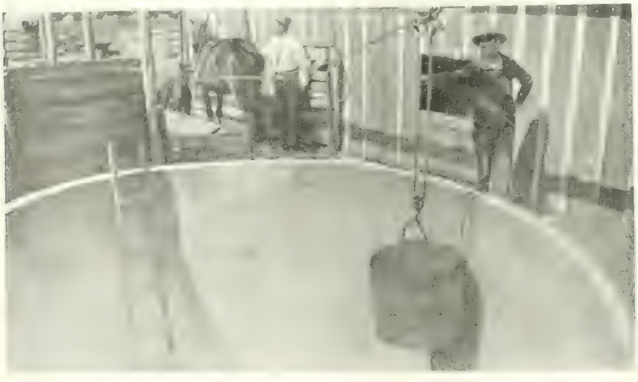


Fig. 2—A Pit Silo [illegible] with [illegible] Bucket and a Hay Carrier for Bringing Silage to the Feed Racks

Pit Silo Useful

These inconveniences include the raising of the silage, which becomes more difficult as use of the silage continues. Ingenious devices of various kinds have been put up to faciliate this work, such as the hay carrier rigging and the windlass. Some farmers in the Southwest brought their first year's silage up on their shoulders, in a basket or hamper and found that, in spite of the labor, it paid them to preserve their fodder in its green state.

The pit silo has become such an established adjunct to the southwestern prairie farm that it has been dignified by the issue of a bulletin by the Extension Dept. of Kansas State Agricutural College.

The author of this bulletin, Prof. Clyde McKee, farm demonstration agent for northwest Kansas, made a careful investigation of the subject, found the pit silo practicable and economical and now recommends it in sections where conditions warrant its use.

Experts first said of the pit silo that it was better than none. They have since revised their estimate, now declaring it to be preferable to such types of high silos as are apt to dry out and collapse in the dry, windy sections of the Southwest. Some farmers are adopting what they declare to be the ideal type of construction, namely a combination of ⅓ pit and ⅔ above ground. This cuts down the power needed for filling the silo, and does not add unduly to the cost of raising the silage after its surface gets below the top of the ground. This type of silo is, of course, of concrete construction. About the best example of such construction is to be found on the Chase farm, near Pawnee City, Neb.

Experience with the pit silo has emphasized again the many uses to which concrete can be put on the farm.

Construction Methods Used

In building the collar or curb for a pit silo, Prof. McKee recommends a 1:2:4 mixture, using cement, sand and broken or crushed rock, providing that hard, flinty rock is available. Where sand only is at hand the mixture should be 1:4, using cement and sand, respectively. If the sand contains considerable coarse gravel, 1:5 mixture may be used and this mixture should be used quite wet. If the concrete is well mixed, little, if any, reinforcing will be necessary, although it is an advantage to use old wire or strap iron for this purpose. The curb should fill a trench 18″ to 20″ deep and it should extend from 1′ to 2′ above ground, or sufficiently to shed surface water.

After the concrete in the curb has set for 24 hrs., excavation of the pit may be begun. The inside diameter of the pit must be made exactly the same as the inside diameter of the curb. After digging down about 5 ft., the walls should be carefully trimmed to make them smooth, and then plastered with cement—using a 1:2 mix. The thickness of the plaster, says Prof. McKee, will depend somewhat upon the smoothness of the walls, but it should average at least ¾″ to 1″ thick. If the plastering is too thin it is likely to crack and fall off. After the first course has been plastered, another 5′ are dug out and plastered, as before, the work thus continuing until the desired depth is reached. A coat of cement wash is given the wall after the plastering is finished, in order to make it air tight. A concrete floor is not necessary, but some builders consider it advisable. A roof is an absolute necessity, the usual plan being to build a shed over the silo, this shed covering also the feeding trough.

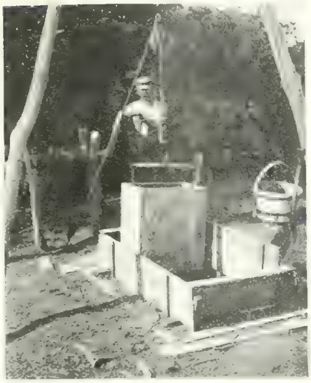


Fig. 3—Pit Silo at Norton, Kans.
This shows a poured silo and the method of hoisting silage. A bottom-dump bucket is used, emptying into wheelbarrows

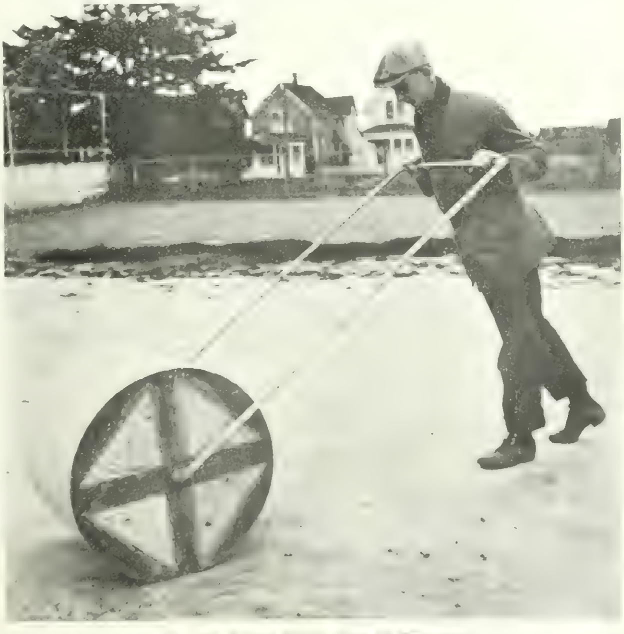
Danger of Carbon Dioxide

There is just one danger in using the pit silo, and that is the formation of carbon dioxide. This gas, being heavier than air, remains at the bottom and, if present in sufficient quantity, might cause suffocation to anyone descending into the silo. The presence of this gas is detected by lowering into the pit a lighted lantern. If the light goes out it indicates the presence of gas, which can be diffused by dropping a few bundles of hay or other fodder into the silo. This gas, however, forms only at the time of filling or when fermentation is in progress being seldom present at the time when the silage is fed. Prof. McKee, in his investigation, was unable to find any pit silos in which gas was present; nevertheless, he deems the warning necessary, as it is an easy matter to apply the test that will guard against all danger.

A Home-made Concrete Roller

The serviceable concrete roller illustrated herewith, consisting of two sections, was recently constructed by a western man. Circular wooden end-forms 2¼′ wide and 1¼′ long were made for each roller, and around each form a sheet of galvanized iron was fastened. A piece of gas-pipe was run through the center for the insertion of the handle and the forms were then filled with concrete. The wooden forms were allowed to remain as a permanent part of the roller.

The handle is of gas-pipe and can be readily reversed. The twin cylinders permit easy turning and prevent tearing up the ground. The roller weighs about 900 lbs. and cost $4.25. In the West, where iron is expensive owing to the heavy freight rates, such a roller would cost about $35 if constructed of iron.



A Lawn Roller Easily Made of Concrete

Hydrated Lime—What It Is, and How Used

BY RICHARD K. MEADE*

WITHIN THE PAST FEW YEARS "hydrated lime" has become a well-known term in the construction field. The following article by an authority in the field, presents a comprehensive discussion of the part hydrated lime plays in the field of cementitious materials.

Within the last few years the users of cement have heard a great deal about "hydrated lime." This is because, unlike quick-lime, it can be used with cement and when so used, confers upon the resulting concrete certain good properties, notably rendering it more nearly impervious to water, lightening its color and making it take a clearer impression of the molds and flow into the latter more easily. The question is therefore often asked by cement users: "What is hydrated lime?"

When a chemical compound is combined with water the chemist gives it the name "hydroxide" or "hydrate." Hydrated lime or lime hydrate is therefore a compound of lime and water. Thus we see that the name "hydrate" as applied to lime really means some property of the lime and is not merely an indefinite term, like the word "Portland" for example, which was applied to cement because the concrete made from it looked to the inventor like stone from the quarries at Portland, England.

Lime Putty

"Lime putty" or the paste resulting when lime is slaked in a mortar box is also hydrated lime. Chemically, there is no difference between the two. Practically, the difference is this. When the mason slakes lime in a mortar box, he adds to the contents of this sufficient water not only to combine with the lime, but also an excess; the latter remains after the lime is slaked and forms with the slaked lime a paste or putty. In the manufacture of hydrated lime, however, just sufficient water is added to slake the lime and what small excess is employed is driven off by the heat of slaking.

When lime slakes it merely combines chemically with water. Fifty-six parts of pure lime combine with 18 parts of water. These proportions are as fixed as the laws of gravitation. If we mix with the 56 lbs. of lime a little over 18 lbs. of water, the lime will take up only 18 lbs. of water and, provided the quantity of water is not much greater than 18 lbs., the excess of this will be driven off by the heat generated when the lime slakes. If we use a great excess of water, say 50 lbs., the 56 lbs. of lime will still take up only 18 parts of water, some little will be driven off by heat and the rest of the water will remain mixed with the hydrated lime to form a paste or putty.

Hydrated lime therefore, is nothing more or less than dry slaked lime. In its manufacture, the quantity of water used to slake the lime is so regulated that the small excess over and above that needed by the lime is driven off by the heat generated in the slaking of the lime.

Manufacture of Hydrated Lime

In the process of manufacture used in this country, the lime is first crushed to the size of a pea. It is then introduced into a machine called a "hydrator," in which the water is added and the mixture stirred by means of paddles or plows until the lime has slaked to a perfectly dry powder. This dry powder is then generally passed through some separating system which removes from the fine powder all of the coarse pieces. These latter consist of unburned limestone, silicious cores and unhydrated lime. (The process of manufacture will be more fully described in a future article).

The advantages possessed by hydrated lime over lump lime are numerous. There is, however, one objection to it, viz: that it is not quite so plastic as lime slaked to a putty in a mortar box, hence many plasterers prefer lump lime. This is particularly true of high calcium limes. Masons and plasterers, however, are fast learning that the objection raised as to plasticity is more than balanced by the convenience with which hydrate can be handled.

When lime is exposed to the air it absorbs not only water, but also carbon dioxide and does what is known as "air slake." If water only were absorbed, the effect would be only to convert the lime into hydrated lime, but where carbon dioxide is absorbed the effect is to form carbonate of lime. Carbonate of lime and limestone are chemically the same thing and of course neither of them has any binding effect. In the formation of carbonate of lime, practically speaking, the lime reverts back to its original condition before it was burned. When lime air slakes the lumps break up and fall to a fine powder. If this powder is analyzed it will be found to consist of a mixture of carbonate of lime and hydrated lime and when tested will be found to have only a part of its original usefulness. Masons therefore formerly had a strong prejudice against fine lime. When hydrate first came out, it found much opposition, probably some of it fostered by the lump lime people, because its finely powdered condition led many to believe that it was air slaked lime. This prejudice has now disappeared, however, as hydrated lime is so extensively used that masons and plasterers are familiar with it and know the vast difference between the two—viz: that air slaked lime is lime that has reverted to limestone and that hydrated lime is dry water-slaked lime.

Difficulty of Keeping Quicklime

The property which lime has of absorbing water makes it not only a hard but a dangerous thing to keep. It also requires an expensive package. Some lump lime is shipped in bulk but much of it, particularly the better grades, is shipped in barrels. Lime will keep much longer in barrels than it will in bulk, but even in these it air slakes rapidly and becomes worthless. Furthermore the barrels are expensive, usually amounting to from $2.00 to $3.00 per ton of lime. Hydrate, on the other hand, may be shipped in paper, cotton or burlap sacks. It is usually packed automatically by means of Bates automatic[1] packers into paper bags holding 40 lbs., or into cotton, or more generally, burlap bags, holding 100 lbs. The cotton and burlap bags are charged to the consumer just as in the case of cement and credit is given when they are returned.

Hydrated lime is much more bulky than cement and consequently the sacks must be bigger. Instead of a bag 18"x 36" such as is used for 95 lbs. of cement, the burlap bags used for hydrated lime are generally 25"x42". While, of course, a bag of hydrate is no heavier than is a bag of cement, it is much harder to handle, owing to its size. The burlap bags are so open that the hydrate dusts through them badly and while little of the material is actually lost, the handling of the burlap bags is hard on the men, consequently the introduction of cotton sacks within the last few years into the lime trade. These are made of much lighter goods than are the cement sacks but still cost between 12 cts. and 14 cts. each, so that the consumer is usually charged $3.00 per ton of lime for the sacks; and allowed 15 cts. for each sack returned. In the case of the burlap, the charge is usually $2.00 per ton with 10 cts. per sack rebate.

Keeping Quality of Hydrated Lime

Hydrate will absorb carbon dioxide if spread out in a thin layer. In sacks, however, which are piled together the loss of hydrate from air slaking is very slight. The outer layers of lime undoubtedly serve to protect the rest of the package. In some tests made of hydrate kept all winter in a dry storehouse, the loss was found to be on an average 3%; some of the outside bags showed as much as 5% and some of the inside bags as little as 1½%. In the same length of time a lot of lump lime would have been rendered practically worthless.

One of the great advantages of hydrated lime is, therefore, its keeping qualities. This makes it especially desirable where only a small quantity of lime is used at a time, and over an extended period, allowing the user to purchase lime by the car load.

The lime industry is a seasonal one and generally the seasons are short. The lime manufacturer with kilns only is forced to shut these down when the trade is dull as it is in the winter. If, however, he has a hydrating plant he can run his kilns all the year around, storing his product as orders fall off and rushing it out when trade is brisk.

Fire Risk from Quicklime

The fire risk from storing quicklime is well known by lime dealers. A ton of lime on slaking will give as much heat as 75 lbs. of good coal. If water has a chance to get at the lime and any combustible material such as the barrels in which the lime is kept, the floor and sides of the lime shed, etc., is in contact with the lime, fire is very apt to occur. Many instances of the burning of sheds and storehouses in which lime was stored have come to the writer's attention. Sometimes the fire is caused by a leaky roof and sometimes by the rising water of a flood. Often leaky barges and boats carrying lime have been set on fire and burned at sea by the heat generated by the slaking of lime.

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* [illegible]

[1] Bates Valve Bag Co., Toledo, O.

With hydrated lime there is no fire risk. Since the hydrate has once slaked it cannot slake again. It has the same relation to lime so far as ability to generate heat goes, as ashes have to coal.

Purity of Hydrated Lime

Generally speaking, hydrated lime is much purer than lump lime. This is particularly true of hydrates made by the air separator or the screen process, but is not true of hydrate made by the mill process. In hydrates made by the former process, the impurities are separated from the hydrate, while in the latter they are ground in with the lime. These impurities consist of silicious cores, unburned limestone and unhydrated lime, the latter usually occurring from the overburning and semi-fusing of the lime.

The silicious cores and the unhydrated lime are what cause the "popping" of plaster, the action being similar to the "unsoundness" of cement and from the same cause, viz: the hydration and consequent expansion of the lime after the plaster has hardened. Where the mill process is used to make the hydrate, the cores are ground very fine and consequently can slake quickly and, if not present in too large quantity, before the mixture hardens. With a well made hydrate, therefore, the builder runs less chance of a bad job than with mortar often hastily slaked in the mortar box.

Adaptability

One of the strongest recommendations for hydrate so far as the user is concerned is unquestionably the ease with which it can be used. The builder is saved the expense of carting mortar boxes around. He is saved the delay of waiting for the lime to slake. He always has at hand slaked lime. The streets are not blocked by boxes and barrels full of lime paste. Instead of this, the hydrate has only to be mixed with water and sand and this can be done as well on the sixteenth floor of a sky-scraper as on the ground. For brick and mortar work, it is hard to conceive of any mason using lime putty when the ease with which hydrate can be made into a mortar is considered. Hydrate is particularly well adapted for "patching jobs" and to rush work.

Lime Hydrate Combined With Cement

One of the strongest claims for hydrate is the fact that it can be used with cement. It is only necessary to mix the two and any desired proportions can be employed. For laying brick and stone a mixture of 25 parts cement and 75 parts lime is quite popular. (One bag of cement to three 100-lb. sacks of hydrated lime). The addition of the cement does not appreciably detract from the plasticity of the mortar, while it adds greatly to the strength, particularly at early periods. For stucco, the proportions are generally reversed, (one 100-lb. sack of hydrated lime to three sacks of cement), the hydrated lime adding to the plasticity of the mortar and making it spread more easily. It also makes a lighter colored stucco and adds to its density. For waterproofing, about 15 parts of hydrated lime and 85 parts of cement are used, (or one 40-lb. sack of hydrated lime to two sacks of cement). This same proportion is employed when used in concrete block making. It has been found that up to 15% to 18% of hydrated lime does not detract from the strength of cement mortars.

The addition of hydrated lime to cement mortars acts as a sort of lubricant and causes the latter to flow more readily and to fill the forms and molds more perfectly. It also causes the forms to leave the concrete more cleanly.

Hydrated lime, however, delays somewhat the set of concrete in which it is used and such concrete will not harden quite so rapidly as will plain concrete. It may often be used to retard the set of quick-setting cement.

Much has been said about the waterproofing properties of hydrated lime and concrete in which it has been used is certainly more resistant to water than where it has not been employed. In the laboratory, concrete made with hydrated lime shows quite a high rate of absorption when immersed and, if the Chapman block test is applied to cement-hydrated lime mixtures, these show some improvement over cement alone but still show that water will be soaked up quite rapidly by such concrete.

On the other hand, *hydrated lime in practice has given good results* and in my estimation the reason for this is found in the fact that mortars in which hydrated lime is used flow very freely. Consequently they may be worked in around the aggregate thoroughly and along the face of the forms, resulting herein a surface similar to the troweled top of a cement sidewalk. For making tanks, pits, etc., watertight, hydrated lime will give excellent results. It is not, however, an infallible remedy against damp walls, etc.

Hydrated lime should not be used in concrete subject to sea-water as the writer's experiments show that concrete in which hydrated lime is used is more subject to attack than plain concrete. The same remarks apply to drain-tile subject to alkaline waters.

Coloring Stucco Work

When stucco is used in coloring, the two important factors are uniformity and permanency. The carbon blacks are probably more permanent than the lamp blacks and do not have the same tendency to float in the mixture.

Greens and blues are, as a rule, unsatisfactory to work with. The following table, which was published in a recent Bulletin of the Assn. of Am. Port. Cement Mfrs., states the way to handle the colors for different shades desired:

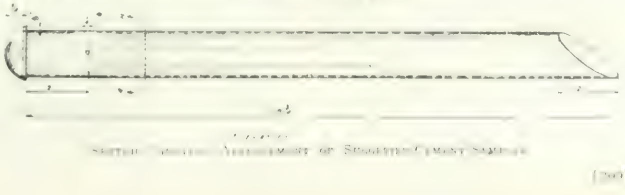
Table — Colors To Be Used in Portland Cement

Color Desired	Commercial Names of Colors for Use in Cement	Prices per Lb. in 100-Lb. Lots for High-grade Colors	Lbs. of Color Required for Each Bag of Cement to Secure: Light Shade	Medium Shade
Grays, blue-black and black	Germantown Lampblack	10 cts.	½	1
	Carbon Black	8 "	½	1
	Black Oxide of Manganese	6 "	1	2
Blue shade	Ultramarine Blue	18 "	5	10
Brownish-red to dull brick red	Red Oxide of Iron	3 "	5	10
Bright red to vermilion	Mineral Turkey Red	15 "	5	10
Red sandstone to purplish-red	Indian Red	10 "	5	10
Brown to reddish-brown	Metallic Brown (Oxide)	4 "	5	10
Buff, Colonial tint, and yellow	Yellow Ochre	6 "	5	10

An Ingenious Cement Sampler

A cement sampler presenting rather ingenious features has been developed by F. E. Martin, Los Angeles, Cal. This sampler as shown in the accompanying sketch, consists of a thin metal tube 19" long and 1¼" in diameter. One end of the tube is sheared at an angle, the other end is covered with a round cap, which fits the palm of the hand. Near this upper end is a small hole which allows the air to escape when the tube is thrust its length into an opened sack of cement. The tube is filled with cement and when withdrawn the hole is closed by the finger which causes the tube to retain the cement.

Mr. Martin does not intend to patent the device, as the field for its exploitation is not large enough to make it profitable, but he suggests that if a sufficient number wish to co-operate in securing one they can be made much cheaper in quantity than singly. He believes they can be made for about one dollar a piece by this plan, and invites correspondence from anyone who might be interested. Mr. Martin can be reached by addressing CONCRETE-CEMENT AGE.



Sketch Showing Arrangement of Suggested Cement Sampler

Molds for Segmental Chimney Construction

AN EASILY CAST WALL UNIT so shaped that while it is placed it forms a vertical opening in which a reinforced concrete stud can be poured is the essential feature of the construction described. Detail notes are given.

In the Jan., 1913, issue a system of chimney construction was described, in which the essential feature was the use of a horizonal pre-cast unit so formed as to produce a wall and a vertical stiffening rib. This system, which was developed in Europe by Monnoyer & Son, of Brussels, has been successfully used for chimneys, water towers and divers other constructions, and the following notes describe in detail the methods used in casting the mold.

The Mold Used

The type of mold represented in Fig. 1 is designed for casting the segments which compose this system. It has been designed in such a way as to permit the casting of pieces of different length, thickness, and shape, turning them out ready to go into the structure and giving the latter a symmetrical shape. The outside portion of the molds consists of two pieces, *M* and *Q*, with two adjustable joints, *R*, permitting the section *Q*, to be moved in and out.

The section *P* is designed to provide in the middle of the rounded head the groove provided for the insertion of the vertical reinforcement. It has been given a wedge shape in order to make the removal of the casting more easy. This piece terminates in two lugs which are fastened by means of clamps, one to the movable piece, *Q*, and one to the brace, *N*.

The arrangement is completed by means of wedge-shaped pieces of wood as shown on the plan, according to the number of sides of the polygon which it is designed to build. The wedges, *T*, are used to fill the angle between the pieces, *P* and *Q*, up to the line which indicates the number of sides required to make the polygon.

For a 6-sided chimney no wedge, *T*, is necessary. For polygons with 8 to 18 sides six wedges are called into play. The wedges, *S*, serve to close the molds at the rear up to the line showing the number of sides of the polygon required. For a given thickness the use of four wedges is sufficient to cast the segments for a polygon having from 6 to 18 sides.

Making the Units

To cast the segments, the pieces, *P* and *Q*, are fastened in position by a clamp, care being taken that the sides *x* and *y* are held in precisely the same plane. The piece, *M*, is moved toward the interior of the mold, care being taken that the joint, *Z*, is perfectly closed; this joint must be kept perfectly tight. The brace, *N*, is slid along the piece, *P*. When it occupies the position called for by the thickness of the segment, the wedge, *S*, is put in place and the pieces, *M* and *N*, are held by means of a third clamp at the proper point on this wedge.

To release the casting from the mold the three clamps are loosened, the piece, *N*, comes out of itself and the piece, *T*, is withdrawn by pushing it against the body of the segment. To release the rounded head of this segment, it is only necessary to turn the piece, *Q*, around on the hinge.

In order that the segments may have the proper consistency and the uniform color which provide both for the solidity and the good appearance of constructions under this system, it is necessary in molding them to use the same care as is used in ordinary concrete construction, with conditions of mixture and tamping as nearly uniform as possible. Good results are obtained with the following quantities:

Slow-setting Portland cement 300 kgs. (661 lbs.)
Coarse sand 400 liters (14.12 cu. ft.)
Gravel 800 liters (28.24 cu. ft.)

This is mixed with 10% of water by weight of the dry material. There results a mixture which is plastic in consistency and this must be thoroughly tamped until the water rises to the surface. The mass will then have a jelly-like and "quaky" consistency.

Removing the mold from the units may be undertaken a few hours after hardening has begun. The molds may be used over and over again. It is only necessary to take certain precautions in removing the molds. After they have hardened for five or six days, the segments may easily be put in a pile and classified according to their dimensions so that they may be readily located when the work of erection begins. Until they are used they should be frequently sprinkled in order to insure thorough curing.

The platform on which the concrete is mixed should be well built and the molds laid perfectly flat in order to prevent the spilling of the liquid concrete. In every case the pieces should be carefully covered and sprinkled before erection begins.

The mixing room should be covered if possible and in any event must be sheltered in such a way as to protect the concrete from excessive variations in temperature.

Method of Erection

Segments are hoisted on the work by means of a windlass on which a cable travels, guided at the point where it enters the chimney, at the base of the shaft, by a pulley.

At the working level of the chimney there is arranged a scaffolding in the middle of which there is a trap. This scaffolding is attached to the chimney

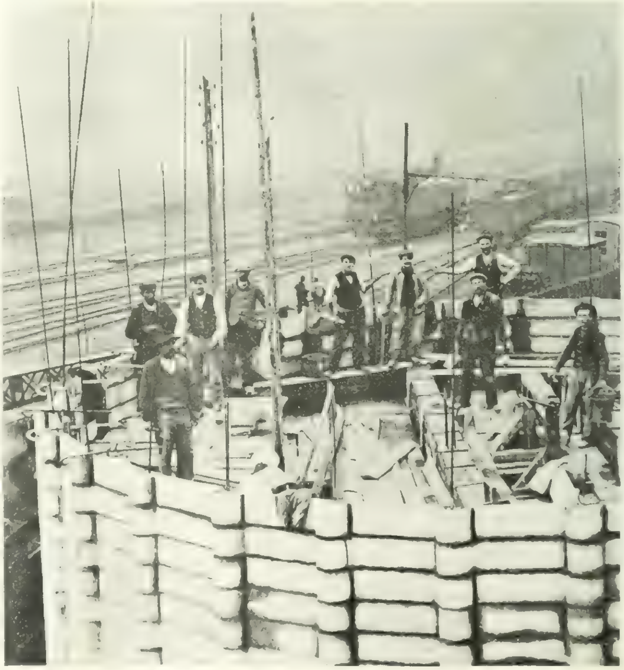
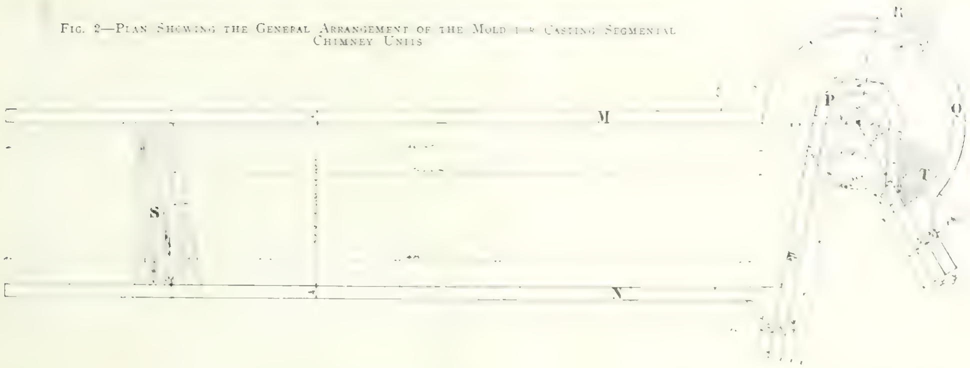


Fig. 1—Detail View Showing Methods of Segmental Concrete Chimney Construction

FIG. 2—PLAN SHOWING THE GENERAL ARRANGEMENT OF THE MOLD FOR CASTING SEGMENTAL CHIMNEY UNITS



walls. Above the level of the work there is arranged a pulley over which passes the cable.

Segments are laid on the mortar joints about 1 cm. (⅜″) thick. These joints are troweled as the work progresses, as is the case with rodinary masonry. At the top, the outside of the chimney is concreted over for a distance of from two to four courses of segments.

In order that the reinforcement, of whatever type is used, which is placed in the frame work of concrete chimneys may develop all the resistance which is called for in the design, it is required that concreting around it shall be done with extreme thoroughness. Otherwise the bond of the concrete with the reinforcement is not so complete as it should be.

It therefore recommended that the workmen take unusual care in mixing and placing the concrete which is used in the supporting ribs of the chimney and that this concrete be poured with great care and thoroughly tamped, care being taken at the same time that the vertical reinforcement is not disturbed, so that the bond between it and the concrete is not interfered with.

In order to insure the security of the reinforcement, it is good and not at all expensive, to provide the reinforcement with a hook at each end, which may be bent into the reinforcement to which it is connected.

By taking care to place these hooks in the same plane for the lower and for the upper reinforcement, the lower hook of the upper bar being located in a layer of concrete which is still green. as soon as the two bars are tied together there will be formed a more perfect union than could be had by simply crossing the bars.

It has often been noticed that owing to insufficient tamping, the concrete of the supporting ribs does not adhere as perfectly as it should to the walls of the segments.

It has been suggested in a number of cases, that the interior walls of the supporting ribs should be roughened when the segments are taken out of the molds. It seems better still, in order to make sure that this plan is carried out, that provision shall be made in the interior wall of the supporting ribs of each segment for two horizontal grooves which could be easily secured by inserting rings which would provide for the easy removal of the segments from the mold.

It is probable that the concrete work on the ribs would be greatly facilitated if, for large chimneys, molds were employed giving ribs with a diameter slightly larger than those which are ordinarily employed.

The concreting will also be made much cheaper if care is taken to figure accurately the lengths of the segments in such a way that when a new series of castings is begun, the right end of one segment will come within 1 cm. (⅜″) of the interior wall of the rounded extremity of the segment next to it, and when the last course of segments of the same width is complete, this right extremity will pass by 1″ only, the interior wall of the rounded portion. As a matter of fact, the space left for supporting ribs is more important than when the constructions are strong.

There have been observed a number of linings of brick which have been put up very carelessly, with the result that instead of protecting the concrete wall, they brought about, through their disintegration or failure at certain points, accidents due to differences in temperature where one portion of the chimney grew very hot while other portions near it remained cold. It is recommended especially that in installing brick linings in chimneys, they shall be put up without touching the concrete at any point.

Unit Prices Giving a Uniform Net Price for a Chimney in France

Concrete:—This is uniformly composed of a mixture of 800 liters (28.24 cu. ft.) of gravel, 400 liters (14.12 cu. ft.) of sand and 300 kgs. (661 lbs.) of cement, equivalent to a 1:1⅔:3⅓ mix. The mixture of this concrete varies according to whether it is used in the foundation, in the base above the ground or the base below the ground.

Gravel costs 8 fr. per cu. m. ($1.30 per cu. yd.) delivered on the work; sand costs 4 fr. per cu. m. ($0.65 per cu. yd.) delivered on the work; cement costs 40 fr. per ton. ($3.60 per 1000 lbs.) delivered on the work. The ordinary

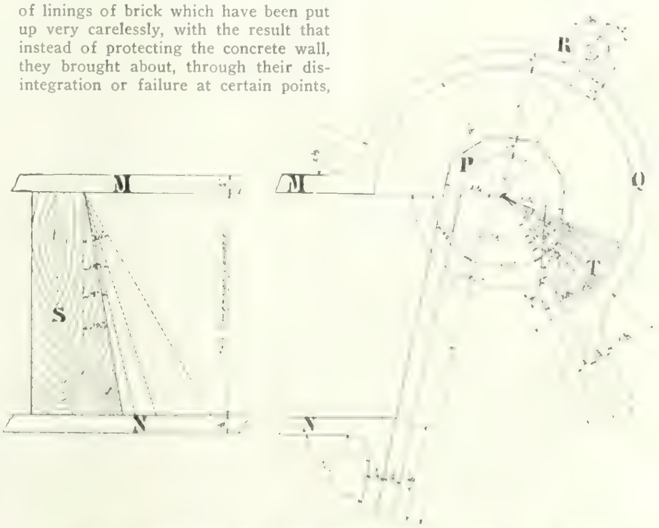


FIG. 3—DETAIL SHOWING WEDGE WHICH CLOSES THE END OF THE BLOCK. The shape of the ends of the blocks depends on the number of sides of the chimney

wages of workmen give the following figures for labor per cu. m.

Foundation, 7 fr. or a total of 27 fr. ($5.40).

Base at ground level, 8 fr. or a total of 28 fr. ($5.60).

Base above ground level, 10 fr. or a total of 30 fr. ($6.00).

Steel:—The price of this delivered on the job being 20 fr. per 100 kgs. ($4.00 per 220 lbs.), we estimate the fabrication at 4 fr. ($.80 per 220 lbs.), or a total of 24 fr. ($4.80).

Casting:—Concrete and steel are figured at their gross prices. The manufacture of the segments is estimated at .65 fr. each ($.13), two men and a boy being able to make 40 in 8 hours with an outfit of 20 molds in good weather, removing them morning and evening, at the rate of 40 pieces in 8 hours.

Erection:—A force of 2 men on the chimney and 3 working at the foot can erect 1¾ m. (5' 9"), that is, 7 courses of segments, per day.

With an eight-sided chimney this gives for the net cost of erection, counting the steel, the concrete and the erecting apparatus, .85 fr. ($.17) per segment, as a maximum.

The iron ladder is estimated at 8 fr. per m. ($1.60 per 3.2083 ft.). The interior lining of half bricks at 6 fr. per sq. m. ($1.20 per 1.1960 sq. yd.)

Quality of Material:—The cement must be of the first quality without free lime. The gravel and siliceous sand must be free from calcareous or argillaceous materials and from earth.

The molds, of which a series of 20 to 25 is sufficient, weigh from 80 kgs. to 100 kgs. (176 lbs. to 220 lbs.) and cost from 15 fr. to 20 fr. ($3.00 to $4.00) apiece They can be used over and over again.

It is well to allow a slight excess for the special workmanship on the segments to be used at the top, molded on the ground in wooden forms. In this particular case, they might cost about 70 fr. ($14.00).

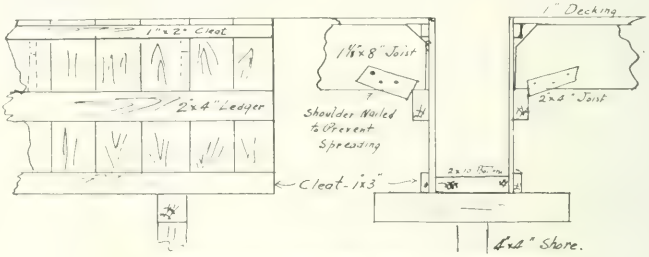
Summarizing a recent paper by H. Burchartz published in a German technical paper, *Chemical Abstracts* says:

Tabulated strength tests, using 12 different samples of trass and tufa hardened under different conditions, are given. The results showed that the addition of trass had a retarding effect on the hardening of cement concretes; the effect was eliminated by mixing the specimens with $Ca(OH)_2$. The unfavorable effects of mixing soap solutions with the trass were likewise lessened and impermeability was increased. $Ca(OH)_2$ on trass-free specimens had no influence on strength or permeability and soap solutions lowered the strength when no trass was present. Soap solutions, however, made all mortars and concretes impermeable and increased the strength in the presence of trass.

Using Light Lumber for Beam and Girder Sides

The following notes cover a rather ingenious development in centering work which was used several years ago on work of the Carey Const. Co., in Cleveland. The centering was designed by W. S. Ferguson, formerly ch. engr. of the company, and erected under the supervision of A. B. Loomis, foreman. Centering economy is a very important question in handling concrete work, and the following notes, sent in by one of the men on the work, should be of interest to CONCRETE-CEMENT AGE readers:

It is usual practice in floor work to use 1¾-in. timbers for beam-sides. On the work in question we went to the other extreme with considerable success and used ½-in. boards. This sounds extraordinary, but it is true that the light beam-side worked out very well indeed.



SECTION AND ELEVATION OF BEAM SIDES USING LIGHT LUMBER

In the first place, the centering was designed to develop lumber economy. We would order at the mill 2" x 6"'s and 2" x 8"'s "surfaced both sides," and have them ripped into boards 1⅛" and ½" thick, allowing ⅛" for the cut and surfacing. On the saw-mill we had on the job the ½-in. stuff was rapidly cut up into short boards 22" long, which was the depth of the average beam-side throughout the work. These short boards were framed into beam-sides as shown in the enclosed sketch; ⅞" down from the top a 1" x 2" stringer was run, about midway a 2" x 4" ledger and at the bottom a 1" x 2" stringer. Blocks 2" x 4" were used in between to brace the stringers and to help the 2" x 4"'s carry the weight of the joists. A 1⅛" material was used for joists and cut off at the top corners as shown.

Using Light Joists

The use of 1⅛-in. material was the result of a careful analysis of the problem. In the first place, when using a 4-in. slab, 20" or 22" is the limit of the distance apart which the joists can be placed so that the 1-in. sheathing will carry the concrete without sagging. On these centers 1⅛" x 8" and 1⅛" x 6" are plenty heavy enough. We found on the work that the joists being lighter were handled more easily and placed more rapidly. A man could pick up three or four of these and walk out along a beam bottom and drop them into place, where he would not have taken any more than two 2-in. x 8-in. joists.

In erection the bottom boards were placed first and supported by shores at the approximate level. These beam-sides were then placed, bolted through the bottom stretcher by a ½-in. bolt which rested on top of the bottom board. This, of course, left a little furrow across the bottom of the girder, which was later covered up by the plaster. If it is not desirable to use bolts, a form clamp can be used just as easily, although the bolts had an advantage in that they held the side units in place. The joists were then placed as shown in the detail. A little 1-in. block was tacked on to the bottom of the joist so as to intercept the 2-in. x 4-in. joists as shown. This helped the beam-sides to withstand any bulging action of the concrete and prevented the end of the joist punching through the ⅛-in. beam-sides.

These beam-sides were used for four floors on the building in question, then were carried to other jobs for other work. As the floors got lighter and shallower on the upper stories, supports were placed on top of the shores and the beam bottom carried up inside the beam-side. We attributed the wearing quality of these beam-sides to the fact for one thing that the grain of the wood was carried in two directions. The only wear shown was a brooming of the ends of the ½" boards under the concrete. Every once in a while boards would be knocked off or broken, but these, of course, were easily replaced. The beam-sides were light and easily handled. Such a detail, replacing as it does a heavier and more expensive beam-side, merits further consideration.

Portland cement is suffering with other materials of construction from the desire of the framers of the new tariff bill to provide a lower cost of living. Cement, lumber and all other building materials are practically to come in free of duty, so that with the free listing of most articles of food under the new bill, the American citizen is hereafter at last to have his board and lodging at minimum rates. As "the proof of the pudding is in the eating," it will be interesting to observe the result of the free listing of these two important lines of commodities.

Maintenance of Wayne County Roads*

The only serious objection that has to date been advanced against the construction of concrete roads is the development of cracks. We do not consider this a material objection, and believe that the formation of cracks can be minimized by careful workmanship, a well prepared sub-grade and proper drainage. We believe the difficulty can be practically eliminated by reinforcing with mesh wire or other suitable material. This entails an additional cost of from 10 cts. to 12 cts. per sq. yd. We have not gone to this extra expense, as we feel that by filling whatever cracks develop with Tarvia X applied hot and covered with coarse sand, we prevent wear and obtain a smooth, even surface. To date this has been done at a less cost annually than the interest on the reinforcing cost at 4% would amount to.

The first roads built by us have developed by far the largest number of cracks, and caused us to change our specifications to those now in use. We have carefully counted the cracks on over 45 miles of concrete roads built previous to Jan. 1, 1913. Every break was counted as either a transverse or longitudinal crack, irrespective of whether it extended the entire width or length of the slab or extended a foot only. Diagonal cracks were counted for the most part in the longitudinal column. Such cracking as develops usually shows within the first year, and we propose making a yearly count to determine to what extent, if at all, the cracking continues after that time. All roads are put down in 25-ft. sections with a transverse metal protection joint. No longitudinal joints are used.

CRACKS IN WAYNE COUNTY ROADS

Road	Year Built	Cracks		25-foot Sections	Date of Count	Course
		Trans.	Long.			
Woodward	1909	34	80	211	Aug. 23	2
Woodward	1910	22	34	254	Aug. 23	2
Gratiot	1911	13	12	326	Aug. 23	1
Mt. Elliott	1910	22	3	172	Aug. 23	2
Mt. Elliott	1911-12	15	1	186	Aug. 23	1
Grand River	1909	2	14	64	Aug. 23	2
*Grand River	1910	49	59	342	Aug. 23	2
Grand River	1911-12	66	96	1748	Aug. 24	1
Fort	1912	28	2	453	Aug. 24	1
Van Dyke	1910	11	14	211	Aug. 24	2
Van Dyke	1911-12	9	15	254	Aug. 24	1
Jefferson	1912	6	31	345	Aug. 24	1
†Michigan	1910	52	240	479	Sept. 1	1
Michigan	1911-12	122	287	3071	Sept. 1	1
River	1910	5	55	149	Sept. 1	1
‡River	1911-12	34	213	855	Sept. 1	1

*Built by Owosso Construction Co.

†This section of Michigan Ave. Road is built partially on the old roadbed, and partially on a fill which is responsible for the large number of cracks developed

‡Taken from count made by State Highway Department

In connection with the above table, it is pertinent to state that out of the large number of miles of concrete road built by our own forces which have been subjected to the test of time and usage, not one single section has been torn up and replaced.

Maintenance

There are two factors to consider in highway construction; cost and efficiency. Cost is one of the main considerations of the taxpayer. The moment a road is contemplated, his first inquiry is, "How much will it cost?" The second consideration seems to us to be equally vital, "How good will it be?" This question of efficiency is often overlooked entirely.

Cost must include not only first cost, but maintenance. The prevailing opinion seems to be that, once built, a road is for all time finished. This is a fallacy; no road is ever completed, because it is at all times subject to the breaking down processes of traffic, freezing and thawing; erosion by heavy storm, and the destructive chemical action tending to reduce everything in nature to its simplest elements. Care and maintenance of a road must be started the day the construction is finished, and must be continued for all time. This becomes a fixed charge, which unless the first construction of the road is of such a character as will suitably withstand the traffic it is called upon to carry, will increase yearly until it becomes an annual burden amounting to a large percentage of the original cost.

We believe that if it is worth while to spend millions in Wayne County for good roads, it is abject folly not to protect that investment against absolute loss. To permit a road to go to pieces defeats the very object for which it was constructed. There is no special dispensation of Providence for the protection of a road, and unless continuously maintained, the building of all highways will be a fruitless undertaking.

The efficiency of a road is dependent upon,

1. Economy of tonnage haul per mile. A greater load can be moved in less time on a concrete road than on a macadam or similar type.

2. Adaptability to commercial and pleasure traffic. The road must be built to sustain heavy trucks, high power autos, auto trucks and horse-drawn vehicles, and minimize the dust nuisance.

3. General condition for traffic throughout the year. The road that requires least repairs is in best condition for traffic at all times.

4. Degree of safety to travel. The road should be free from ruts and chuck holes, and the surface of such a character that it is not at any time slippery.

5. The probable increase of traffic due to improvement.

Needless to say no type of road is a panacea for all road ills, but we believe that in the concrete road as developed and built by our crews under our supervision and guidance, we come more nearly to obtaining a road that combines the highest economy and efficiency based on the broad principle of ultimate cost than is obtained in other types of construction. A comparison of our maintenance costs with those of other localities where roads are maintained in good usable condition, and where $1,000 per mile and upwards per year is being spent on maintenance, will prove illuminating. A special feature of the concrete road as being constructed in Wayne County is its uniformity of wearing surface, a surface that does not give away in any one spot, while it withstands traffic generally over its surface fairly well. This is made possible by a careful selection of material, by our methods of measuring the aggregate, and care in finishing and curing so that uniform wearing surface is obtained, and is a big factor in eliminating maintenance costs.

We are attempting to maintain our roads in the same condition as when first built and how far we have succeeded must be left to the judgment of the road user.

With the limits of the city of Detroit as a starting point, there are 150.358 miles of improved roads in the present system of improved roads in Wayne County. This mileage includes the main paved streets in the villages through which the trunk roads pass, through the city of Wyandotte on what we call River Road and the water bonded macadam road on Mack. We have taken over as county roads 132.356 miles all of which are now under our jurisdiction except the trunk line roads through the villages of Dearborn and Wayne, and the section of Mack Road in the Village of St. Clair Heights, where we have relinquished our authority.

The major items charged to maintenance are as follows:

Cutting weeds on 129 miles of road (this mileage was gone over from two to four times).

Cleaning out and repairing ditches, culverts and manholes on 131 miles of road early in the summer and again in the fall.

Repairing holes, cleaning and sweeping 1¼ miles of brick road on Michigan Ave. Road.

Resurfacing and repairing tar macadam mileage on Grand River, Gratiot, Mt. Elliott, Fort, River, Mack and Eureka Roads.[1]

[1] As an indication of the expense to which we are put in trying to maintain our macadam roads, the cost on one mile for resurfacing Grand River Road is submitted herewith.

10,000 gallons of Tarvia X on the road	$1,200.00
[illegible]	[illegible]
Labor	747.76
Total	$2,617.16

In addition to resurfacing we were [illegible] compelled to do additional patching both before and after the road was resurfaced.

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*From the Seventh Annual Report of the Board of County Road Commissioners of Wayne County, Mich.

Painting all bridges and guard rails under our jurisdiction.

Oiling 18 miles of gravel road.

Grading, rolling, dragging with split log drag, and repairing 21 miles of gravel road, 6 miles of which required 3" of pebbles to bring the road up to its original condition.

Repairing and grading shoulders on all concrete, macadam and gravel roads. The shoulders on our concrete roads had become built up from the dirt carried on by vehicles from side roads, and were gone over for the first time.

Resurfacing with tar and sand pebbles, wearing surface on ½ mile of concrete on Fort Road, 1¾ miles of concrete on Gratiot Road and about 600 ft. of concrete on Grand River Road.

Leveling arched floor on three concrete culverts.

Doing the necessary grading on earth roads taken over as county roads previous to the time we start the work of improvement on them.

Tarring all longitudinal and transverse cracks which have developed on our concrete roads. The concrete roads built previous to 1913 were treated this year many miles for the first time. The approximate cost of this work was $1,450.

In fact, everything was done and is being done to keep our roads in proper condition for travel 365 days in the year with a minimum use of power and a maximum comfort to the user.

Two maintenance crews were kept in the field all summer and a third crew part of the time. One crew devoted its entire time to our gravel mileage; the other crew to the macadam, brick and concrete mileage, with the assistance part of the time of the third maintenance and patrol crew. The total expenditure from Oct. 1, 1912, to Sept. 31, 1913, inclusive was $30,533.68. We believe that no other community with an equal mileage of roads maintained as carefully and as systematically can show so low an expenditure for maintenance and so satisfactory a result.

"The Green Report" on Wayne County Roads

EDITORIAL DISCUSSION

In the language of the seventh annual report of the Board of County Road Commissioners of Wayne county, Mich., concrete may "not be a panacea for all road ills," yet CONCRETE-CEMENT AGE believes that the Wayne county commissioners have achieved something in road construction, fully worthy of all the attention which has been given it. Thousands of road builders and laymen interested in good roads have investigated the Wayne county roads and a great many of them have gone home and proceeded to "do likewise" as nearly as local conditions would permit them. One of the communities which thought of doing likewise is the city of Highland Park, Ill., a suburb of Chicago, yet before proceeding with the work along the line of Wayne county construction, interested people engaged the services of P. E. Green, an engineer of Chicago, to make an investigation of concrete roads and pavements in Wayne county and elsewhere, with the idea of determining whether or not, in his judgment, such construction was suitable for Highland Park. Mr. Green, according to his report, devoted three days, June 18, 19, and 20, this year, to the examination in Wayne county, which in this length of time must have been cursory, and when he wrote his report it was, so far as Highland Park is concerned, adverse to the use of concrete as a paving material.

Since that time Mr. Green's report has been given very wide publicity and has been urged upon the public particularly by interests inimical to concrete, under such headlines as "The Truth about the Wayne County Concrete Roads."

Undoubtedly any conscientious engineer, in making an investigation like that made by Mr. Green, would seek to come as near to a truthful report as possible, but whether his time was limited for making observations, or the observation itself was inaccurate, the fact remains that while much of the Green report adheres pretty closely to the truth, it contains numerous rather broad and general assertions which do not find support by several other investigators. And further than this, the Green report seems to err with some frequency on the side of *omitting some truthful statements,* with the result that a half truth carries a false impression.

When Mr. Green's report first appeared, CONCRETE-CEMENT AGE was unwilling to leap into a contradiction without first having data prepared from a most painstaking analysis, but now, aside from our own observations, we have available data prepared by Frank F. Rogers, State Highway Commissioner of Mich., and the seventh Annual Report of the Board of County Road Commissioners, this report covering a period from Oct. 1, 1912, to Sept. 30, 1913.

To aid in clearing up more definitely some impressions of the Wayne county roads, given by Mr. Green's report, we are quoting portions of this report, interspersing these quotations with our own account based upon the investigations mentioned. The quotations from the Green report appear in the smaller type.

Fort Road. Concrete 12′ wide; 3,000′ long; cost $1.317 per sq. yd.; built in 1910; it is one course (6", 1:2:4) sand and gravel. The surface is concrete, rough and loose, which has been covered with bitumen, which is scaling off in large patches. Joints—at least some are iron bound; concrete is rutted and bad; looks more like plain macadam than concrete.

What Mr. Green has to say about this piece of road is very largely true. The principal thing which he neglects to mention is the fact that this half mile of road was laid on contract, and when completed, was so unsatisfactory, particularly as to its surface, that the county commissioners refused to accept it in the condition in which the contractors left it. In order to get his money out of the job, the contractor was required to put on a bituminous carpet coat with screenings. It may thus be said not to represent the Wayne county work in road building.

Fort Road. Three miles—built in 1912; standard specifications; surface—fine, smooth and attractive; joints—every 25′, armored; cracks—few; crown—flat; maintenance—practically none; traffic—light; only one year old; has best surface of any seen. A fine example of concrete in great contrast to first (1910) section. Roadway width is 12′.

The only comment that need be made on what Mr. Green has to say about this second piece of Fort St., road is that this was built by the board of County Road Commissioners conforming to the regular specifications. Perhaps, however, a more exact report of its condition may be gleaned from the paper by Mr. Rogers, read at the recent road Congress and published in the October issue of CONCRETE-CEMENT AGE, page 154. Mr. Rogers reports that in the 450 25-ft. sections there are no longitudinal cracks, 19 transverse cracks, 9 diagonal cracks and 1 hole, a total of defective sections of 29, or less than 6.5% of the total number.

Grand River Road. 1910 section; 16-ft. road way; 6,500′ long; cost $1.204 per sq. yd.; two course work—4", 1:2½:5, sand and crushed cobbles; 2½", 1:2:3 mix, sand.

Surface.—only fair. East end, badly worn in several points.

Joints:—every 25′; filled with tar.

Cracks:—73 slabs, 1,825′ out of 6,500′.

Crown:—flat.

Maintenance:—filling joints and cracks with tar, and repairing holes.

Traffic:—300 to 750, mixed, mostly autos.

This stretch appears to have had some bad concrete, and joints to be badly worn in spots. Several stretches have been fully tarred and covered with crushed gravel. Road appears to be failing in places. There are thousands of holes.

This piece of work was put down on contract. What Mr. Green has to say about the traffic is a low estimate.[1] Mr. Green says there are thousands of holes. We refer again to Mr. Rogers's paper and it should be said in this connection that Mr. Rogers's paper was corrected September 22, this year. Mr. Rogers found 59 longitudinal cracks, 20 transverse cracks, 29 diagonal cracks and 46 holes in the total of 308 25-ft. sections. Further on we shall mention something of what Mr. Green has to say about the repair gang on the work and compare what he has to say with the information supplied by the board of County Road Commissioners. CONCRETE-CEMENT AGE is credibly informed that the cost of repairing the cracks and holes in the concrete roadways does not exceed $50 per mile per year and that $50 has more than paid the cost in both labor and material in going over many miles of these roads, fill-

[1] Seventh Annual Report, Board of County Road Commissioners, states traffic for week of Aug. 18 to Aug. 25 (7 days of 24 hours), 7,444 vehicles. Two days were rainy with an average of 838 and the average for five fair days was 1,163. Of the total, 7,444, double teams loaded numbered 1,157; single horse, 1,548; double team light, 530; auto, runabout 1,054; auto, touring car, 2,543; motor trucks 391; motorcycles 221.—EDITORS.

ing all holes besides cleaning out and re-filling expansion joints and other cracks where such re-filling has been necessary. If the hole is no larger than might be made by a 1½-in. stone loosened from the roadway, or by the wearing away of a little ball of clay of the same size which may have got into the mix, the repair gang fills this hole with tar and sand. CONCRETE-CEMENT AGE has already pointed out that the repair gang is not instructed to carry a cloth along to wipe off the pouring pot. Drops of tar occasionally occur where they are not needed, and in filling a hole, an excess of material is almost always used; this being soft, is soon ironed out by heavy traffic so that it occupies considerable area, while the defect itself is usually somewhere near the center and is very small. This may be verified by anyone who cares to take the pains to go over the roads and pick up the tar here and there with a penknife.

Grand River Road: concrete, 16' wide, 13,255' long; cost $1.718 per sq. yd.; built in 1911; one course 7", 1:1½:3; "Baker" joints; all work of 1911, same mix, using washed sand and pebbles.
Surface:—fine.
Joints:—iron bound.
Cracks:—few (30 slabs, 769' out of 13,255).
Crown.—flat—3 inches.
Maintenance:—There seem to have been hundreds of little holes started which have been filled with tar and covered with sand. Maintenance probably quite heavy on this stretch. Evidently faulty concrete which has evidently been promptly repaired by county.

Mr. Green mentions hundreds of little holes. As a matter of fact, Mr. Rogers, in the most painstaking investigation, was able to find 6 holes in the 515 25-ft. sections. Mr. Rogers found 3 diagonal cracks, 26 transverse cracks and 13 longitudinal cracks. Mr. Green particularly mentions that there is evidently faulty concrete promptly repaired by the county along this stretch. We cite an editorial published on p. 47 of the Nov., 1911, issue of *Concrete*, in which we call attention to a piece of concrete road 9' wide put down on Grand River Ave. on contract by Redford Township. Attention was called to this defective work immediately after it was complete, and the very next year the Board of County Road Commissioners took over this section of concrete road, tore up all of the faulty concrete and rebuilt the 8,000' of work under the county specifications. Thus, a large amount of broken concrete is found strewn along the highway over about 1½ miles on Grand River Ave. Further attention was called to this matter in the data published in the Sept., 1913, issue of CONCRETE-CEMENT AGE, p. 110.

Grand River Road: 6 miles, built in 1912, mix 1:1½:3.
Surface:—smooth.
Joints:—iron, considerable scaling at nearly all and pit holes at a few.
Cracks:—many, not counted.
Crown:—flat.
Maintenance:—on lower part (1 mile) a great many holes which required filling with tar. On this part of this section and the 1911 section, there were [illegible] small holes to be repaired, outside of which concrete seemed good. After a rain, however, many porous spots are noticeable, and it is probable that many more holes will develop.

In connection with all the Grand River Ave. work it should be borne in mind that until taken over by the Board of County Road Commissioners, a large part of this highway was probably the worst of the main arteries out of Detroit. It was an old plank road and when a permanent road was constructed, considerable fill was required over long stretches. Any impartial observer riding slowly over the 11 miles of concrete on Grand River Ave. and watching the occurrence of cracks, particularly in the 1911 and 1912 work, will be almost certain to observe that these cracks are bunched and that they are almost invariably in distinct relation to dips and to fills. Elsewhere in this issue A. N. Johnson, State Highway Engineer of Illinois, in discussing the paper by Mr. Rogers, points out that sub-grade conditions as to firmness and drainage are undoubtedly responsible for the greatest number of cracks.

Mack Road:—Concrete; 15' wide; 1,600' long; cost $1.347 per sq. yd.; built in 1910; one course 6", 1:2:4 of mixed sand and gravel. In very bad condition; many holes and cracks; has been covered with "Dolarway" (1912 report) but that is practically all gone. Traffic is fairly heavy, with much teaming.

Mr. Green also calls attention to this piece of Mack road without mentioning the fact that it was not built by the Board of County Road Commissioners, but was laid on contract. It has been unsatisfactory to the commission from the outset.

In commenting on Mr. Green's report on various sections of this roadway, we have picked out for quotation those paragraphs in which Mr. Green seems to have found the most fault. In his description of each separate piece of work as in the paragraphs thus far quoted he is less glaringly at variance with other reports than in his statements as to maintenance and his general assertions with which the report is concluded.

For instance, Mr. Green assumes "that 15% of all the slabs are cracked and that these cracks in order to prevent them from disintegrating into wide holes under traffic, must be filled with tar and sanded; and that all the joints between the slabs on the work laid previous to 1911 must be similarly filled." We present Mr. Green's figures in detail:

There are 211 slabs per mile of roadway.

65 (miles) x 211 (slabs)..	13,715 slabs.
15% of 13,715............	2,058 cracked slabs.

The 1909 and 1910 work as taken from the reports, amounts to a total of 12.4 miles.

12.4 (miles) x 211 (slabs)........	2,616 joints.
The average length is assumed to be 18'.	
The total number of joints and cracks to be filled, therefore....	4,674

MATERIAL REQUIRED

The estimated quantity of tar for each crack:
½" x 2" x 18' (size of each crack)
½" x 4" x 18' (width of tar)
The total for each crack therefore, is 1.875 gallons.
For each joint.
½" x 2" x 18' (size)
½" x 6" x 18' (top)
Requiring 3.75 gallons.

Total tar for cracks: 2,058 x 1.875..............	3,859 gallons
Total tar for joints: 2,616 x 3.75..........	9,81[illegible] gallons
Total tar required	[illegible] gallons
Average cost of tar per [illegible]	[illegible]
Cost of tar therefore............	820.14
Sand required [illegible] $1.25 ...	[illegible]
Total cost of material	[illegible]

Again says Mr. Green:

The repair of the concrete roads is taken care of by two gangs part of the time and one gang all of the time. These repair gangs consist of a team hauling a wagon-load of sand and a small tar kettle holding about 200 gals., and in addition, five men and a foreman. The cost of this gang is as follows:

One team at $5.00 per day.....	$ 5.00
One man at $3.50 per day......	3.50
One man at $2.50 per day......	2.50
Three men at $2.25 per day....	6.75
One foreman at $4.00 per day..	4.00
Coal for heating tar...........	.50
Total labor of this gang per day	$22.25

This gang proceeds regularly over the roads, and where the repairs are not too heavy, such as removing entire slabs, etc., will average about a mile per day of concrete surface repaired. On 65 miles this would mean a labor cost of $1,446.20, to which must be added the cost of the tar, $932.64, making a total of $2,378.84, which represents the 1913 repairs. It may be estimated that the 1912 repairs performed by this gang was at least 60% of the above amount.

Mr. Green's figures on the labor cost of the repair gang are very nearly correct, but he spoils his impression of accuracy with the interjection "and where the repairs are not too heavy, such as removing entire slabs, etc." The fact of the matter is, no slab of concrete laid by the Board of County Road Commissioners of Wayne County has ever proved sufficiently faulty to require its removal. This is a most remarkable situation and Mr. Green's impression is something quite different. And then says Mr. Green:

Of all the roads Grand River road is the worst in respect to the very large number of small holes which had to be filled. It is estimated that in 1910, 1911 and 1912 work on the Grand River road there are not less than *five thousand small holes which have been filled*.[2] This is very vividly shown in one of the photographs. If we take the average hole to be 6" x 6" x 1" in depth, it will require 0.0208 cubic feet of material to fill it and will be 0.25 sq. ft. of surface. Five thousand such holes will require 104 cu. ft. or 780 gals. of tar and if we assume that all the rest of the roads have only 33-1/3% of the same pro portion of holes then there would be a total of 15,000 holes to be filled and the cost of making these repairs is as follows:

2,340 gallons of tar at .06 per gallon	$140.40
Sand to cover holes, 100 cu. yds. at $1.25...............	125.00
Total cost of material.....	$265.40
Labor (same gang at $22.25 per day) cleaning out one hole every minute, or an average of 600 holes per day, making an average cost per hole of .037 and a total cost for 15,000 holes................	$555.00
Total cost of labor and materials	$820.40

Mr. Green estimates that there are 5,000 holes in the Grand River road, each hole having an average size of 6" x 6" x 1" deep. This is absurd. Mr. Rogers's report (see table, page 189, Oct., 1913, issue, which was corrected to September 22) gives a total of 333 holes in 11 miles of road, and from a careful investigation of many of these holes, we are of the opinion that 50% of them are not greater in extent than half the size of a hen's egg. In this connection and as an answer in general to Mr. Green's criticism, we refer to generous quotations from the seventh Annual Report of the Board of County Road Commissioners published elsewhere in this issue. Portions of the report quoted give information as to cracks covering even greater mileage than is included in Mr. Rogers's report, and also information as to maintenance which any interested person can verify.

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[2] [illegible]

An English Fire Test on Concrete Doors

The British Fire Prevention Committee, London, has recently conducted some very interesting tests on fire resisting doors, and in its red book No. 173 it has presented a complete report of these tests. The first test was conducted on the following specimens:

No. 1. A door, approximately 4′ x 7′, with T-iron rim and expanded metal and flat iron reinforcement filled in with talc and breeze concrete and hung on runners and made to slide, fixed on the outside of an opening.

No. 2. A door, of the same size, with T-iron rim and expanded metal and flat iron reinforcement filled in with chalk and breeze concrete and hung on runners and made to slide, fixed on the inside of an opening.

The object of the test was to record the effect of a fire of 150 min. duration at a temperature gradually increasing to 1,800° F. (982.2° C.) and not exceeding 2,000° F. (1,093.3° C.), followed by the application of water for 2 min. on the fire side.

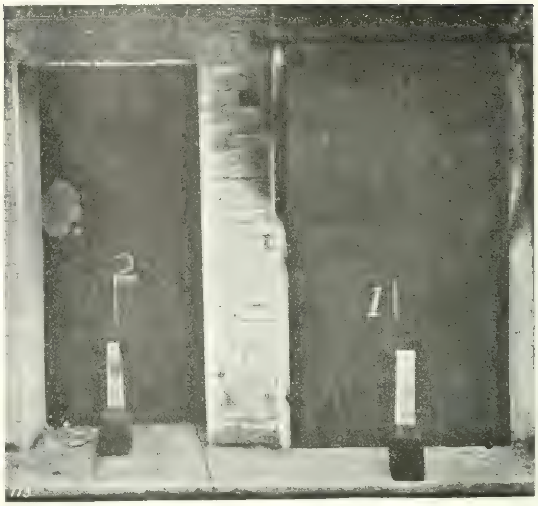

Fig. 2—The Doors From the Outside After 150 Minutes of Fire

The Testing Plant

The testing chamber was built of stock brick laid in lime mortar and the compartment used for this test measured 10′ x 10′; the ceiling was 7′ 9″ above the pavement of the chamber and was constructed of concrete. Fig. 1 shows the general arrangement of these test doors.

Construction of the Doors

Each of the doors was a sliding door with runners along the top. They were built inside of a T-iron frame braced as shown and covered with concrete on a small mesh expanded metal. The concrete for door No. 1 was composed of 1:1:1 mix, using talc powder, furnace breeze and Portland cement.

The concrete for door No. 2 was composed of a 1:1:1 mix, using chalk, fine furnace breeze and Portland cement.

As shown in the section Fig. 1, the concrete mortar was brought out more than flush with the T-iron on either side. Fig. 2 shows doors Nos. 1 and 2 after 150 minutes of fire. At this time the temperature was around 1,800° and had been even higher than this, at some points recording as high as 1,940°. After 90 min. or when the temperature was 1,720°, door No. 1 had expanded vertically about ⅜ in. and the space between the bottom of the door and the ceiling was reduced to nil. Shortly after this the vertical crack shown in Fig. 2, door 1, appeared and through this the flames passed. In 110 min., when the temperature was about 1,800°, the vertical crack down the center of door No. 1 increased to 3/16″. After 150 min. the gas was turned off and water was applied to the fire side of the doors through a ¾-in. nozzle for 5 min. Upon this application of water the irregular patch of concrete in the centering of the door, about 1′ 9″ long and 7″ wide, was displaced.

A week after the test the doors were examined again. It was found that door No. 1 had bulged outward about 1¼ in. and there was a hole through the door about 18 ins. long and 4 ins. wide, exposing the expanded metal. On the outside of the door the runners were intact and it was free to slide. Door No. 2 had bulged inward, the structural part of the door was intact, although several patches of concrete had scaled off. The door would not slide, due to one of the wheels of the runner having become partly fused. Altogether the tests were very satisfactory and show in a remarkable way the fire-resisting qualities of reinforced concrete.

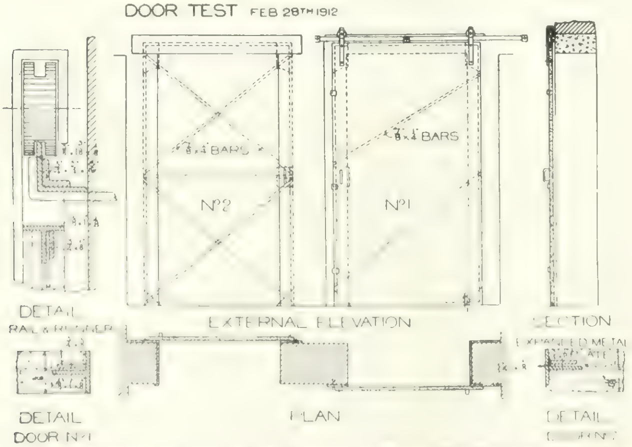

Fig. 1—[illegible] Fire Test of the British Fire Prevention Committee

Quicklime Thaws Frozen Ground

In describing some difficult sewer construction at West Liberty, Ia., Charles P. Chase, the engineer in charge, gives the following details regarding the use of lime to overcome frost:

"The work which was described in a recent issue of *Engineering News,* was carried on through the whole winter when the ground was frozen to a depth of 4′, in which state it resisted all efforts of a trenching machine to break through it. The lime was spread over the frozen ground, covering the width of the trench to be opened and was then broken up into small pieces and covered thickly with straw, hay or manure. Water was then poured on the straw so as thoroughly to slake the lime. Hot water was found best and hastened the slaking. The covering retained the heat, which, with the hot water, penetrated the frozen ground sufficiently to enable the trenching machine to make headway."

Notes on Concrete Highway Construction

THE FIRST OF THE FOLLOWING PAPERS on road problems is an analytical study of the existence and source of what cracks there are in the Wayne County, Mich., concrete roads. The second paper gives some practical points on the maintenance of road equipment; the third article, what one of our staff saw of road methods a few weeks ago.

Concrete Roads in Wayne County*

BY A. N. JOHNSON†

All who are interested in the problems of road construction, particularly of concrete roads, are indebted to Mr. Rogers for the very valuable data that he has presented in his excellent paper, for it is only by the intelligent collection and presentation of such data that true progress in the art of road making can be made.

With so many conflicting reports afloat as to the condition of the concrete roads of Wayne county, it is particularly refreshing to have before us so concise and reliable a statement concerning them. As Mr. Rogers points out, the general condition of these roads is excellent, but as more information is usually to be gained from a study of the defects in any work, this discussion will have mainly to do with such defects and their causes and to suggest such remedies as seem to be applicable.

Mr. Rogers's paper classifies the defects noted in the Wayne county roads under four heads: longitudinal cracks, transverse cracks, diagonal cracks and holes or pits in the road surface. It remains to be seen whether or not the exact causes and consequently the proper remedies for these defects can be determined from our present knowledge. The last of these defects will be discussed first, as there is probably less doubt as to their cause.

Soft Spots

It is evident that if one portion of a concrete road surface, under given conditions of traffic, exhibits a special weakness, it must be due to non-uniformity of the concrete. This will happen if soft pieces of material are in the aggregate. Many gravel banks contain enough soft pebbles to render the gravel useless for concrete road work, though frequently these soft pebbles have somewhat the general appearance of the sound material and, unless a careful examination is made, will not be detected.

Uneven Mix

Another cause for local weakness in concrete is the un-uniform distribution of the mortar and the aggregate. It frequently happens, particularly with very wet mixtures, that the coarser aggregate will not be thoroughly distributed, but will occasionally be separated into small collections or nests of the larger pieces, which contain a very small amount of mortar. There is no mixer that has come under the writer's observation which will mix a batch so uniformly and deposit it in the road so that all portions will contain the proper amount of coarse aggregate and mortar. It is necessary, therefore, in the construction of a concrete road to have one or two men constantly at hand to correct such uneven distribution by shoveling out the pockets of coarser aggregate to be found in the center of nearly every batch that is deposited on the road and replace these pockets with mortar, which usually runs to the bottom and edges of a batch. Where the holes or pits in the road surface are few, their existence is probably due to one or both of the above mentioned reasons.

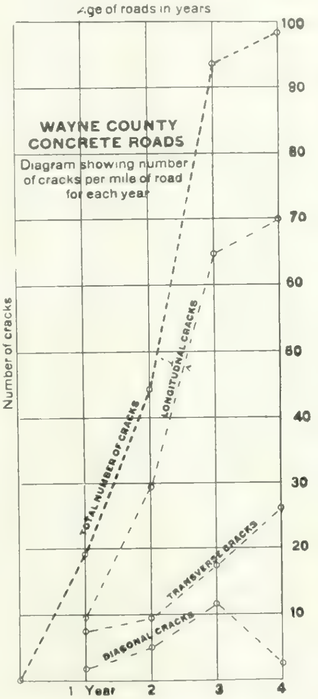

Fig. 1

Improper Curing

Where the surface exhibits a more general disintegration, it will usually be found due, assuming a rich mixture has been used, either to the concrete drying too fast during the period of setting, thereby not curing properly, or, because it has been frozen while setting. It is assumed in this discussion that a rich enough mixture has been employed to insure good concrete, although most complete failures of concrete roads are due to too lean a mix and to poor workmanship. All of these causes are generally well understood and most specifications and approved workmanship seek to avoid them.

The Formation of Cracks

The causes of the first three defects noted by Mr. Rogers are perhaps more difficult to ascertain in a given instance. Before taking up the discussion of the causes, it is of advantage to rearrange the data as presented. This has been done by grouping the data according to the year in which the roads were built, or in other words, according to the age of the various pieces of road. And in order to have a proper basis of comparison, the number of cracks per mile has been computed for the roads built in 1909, 1910, 1911 and 1912, respectively. The results are presented in the following table:

Table No. 1

[illegible]	1912	[illegible]	[illegible]	1909
Transverse	7.4	[illegible]	[illegible]	26.2
Longitudinal	[illegible]	[illegible]	[illegible]	70.0
Diagonal	1.9	4.5	11.7	2.3
Totals	19.1	44.2	[illegible]	98.5

The results in this table are represented graphically in Fig. 1, where the age of the pavements in years is plotted as abscissas and the number of cracks per mile as ordinates.

At a first glance, one is struck with the increase in the number of cracks with each succeeding year. This increase is particularly marked in the first three years, but apparently falls off sharply in the fourth year.

A notable coincidence is that the curve showing the total number of cracks per mile of all kinds is approximately a straight line for the first three years, or in other words, the increase in the number of cracks was approximately the same for each of these years.

There is also considerable agreement of the curves for the longitudinal, transverse and diagonal cracks during the first three years, but no such agreement for the fourth year. It is to be borne in mind, however, that for the fourth year, data are given for only two pieces of road about 1.3 miles in length. However, as these pieces were laid with a leaner mixture than much of the other work and form the first concrete work done by the Wayne county commissioners, all the evidence would point to the conclusion that this stretch of road would show at least as many defects as will appear later in the other roads. But whether or not the conclusion can be definitely drawn that after the first three or four years but few more cracks will appear, must rest on much more extended and detailed data than are to be had at present.

Future Observations Will Be Valuable

The value of future observations to be made at intervals of not less than three months will be evident. These observations should note carefully all the cracks that are found, both as to their character and particularly as to their distribution, so that in the future, the location of new cracks as they appear may be known, as well as approximately the time of the year when they occur. It is believed that the data secured from such observations extending over the next two or three years would shed much light on what at present can be but mere conjecture.

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*[illegible]

†State Highway Engineer, Illinois

Before the arrangement above described was made of the data presented, many other bases of comparison were undertaken with a view to ascertain whether or not any particular feature had a special bearing on the occurrence of the cracks. There was, however, nothing disclosed on which conclusions could be logically based. Neither the width of the road, the proportion of the mixture nor the character of the subsoil prevents any unfailing influence on the defects noted. About the only consistent result to be disclosed was by the arrangement here made.

Causes of Cracks

It may be profitable, however, at the present time to discuss the causes that may be assigned to the development of cracks in concrete roads, basing the observations on the data obtained from the conditions reported in the Wayne county work.

It can be fairly assumed in the present instance that the slabs of concrete may be considered as approximately of the same strength and therefore offer practically the same resistance to all exterior forces to which they are subjected.

Among the forces which would cause the slabs to crack are variations in temperature, extraordinarily heavy traffic loads and unequal settlement of the foundations. It is more than probable that the cracks are due to no one of these causes alone, but rather to their accidental combination. If the changes in temperature were the prime cause, it could be expected that all slabs would show approximately the same number of cracks for the reason that all portions of the road are subjected, approximately, to the same temperature variations. But an examination of the roads shows many slabs in continuous stretches which have not cracked at all, regardless of the age of the road. It can therefore be concluded that temperature changes alone are not sufficient to cause cracking of the slabs in general.

While extraordinarily heavy moving loads may not be so generally applied to all the slabs, and therefore not cause so uniform an appearance of cracks, yet if this be a principal cause, it could be expected there would be a large number of contiguous cracked slabs. But there is practically no evidence to indicate that there have been loads heavy enough to cause the pavements to crack from this reason alone.

The Principal Cause of Cracks

The third cause that has been mentioned, that of unequal settlement of the foundation, is one that would not be generally distributed, for while settlement might occur in one place, there very likely would be considerable distances where it did not occur. Moreover, it will be appreciated that the manifold conditions which would produce unequal settlement would cause an erratic occurrence of any results from this source. And the haphazard occurrence of the cracks would indicate that the cause is not general throughout the length of the roads. The writer is therefore of the opinion that the majority of the cracks are due primarily to unequal settlement of the foundation or sub-soil beneath the broken slabs.

It is quite possible that settlement by itself would perhaps not be sufficient to cause the slab to crack, but on the passage of heavy traffic or with the movement of the slab under temperature changes, there would be added just enough extra stress to overcome the strength of the slab and produce the crack. If, therefore, it is possible in the construction of concrete roads to guard against unequal settlement of the foundation, one of the chief sources of cracks in the pavement will be overcome.

The writer has observed that the concrete slabs composing a concrete road usually do not crack until after they have been in service about a year. The first cracks generally appear in the late spring and early summer following construction. An explanation is that in the winter and early spring the ground is well saturated with moisture which in late spring and early summer dries out and, in case the road bed should dry out unevenly, the consequent settlement would not be uniform.

It is, therefore, particularly important if large concrete slabs are to be maintained intact, to take special precaution with the under-drainage to protect the road bed from becoming saturated and provide a means for thorough and uniform draining of the entire road bed.

Longitudinal Cracks

It is probable, as further studies are made, that the causes producing transverse cracks will be found to be somewhat different from those producing longitudinal cracks One special cause of the latter is to be found whenever a concrete road is built over a hard road bed, the concrete slab being somewhat wider than the compacted center of the old road. The soil at the sides, which is not so compact as the center, will settle more, causing the concrete slab to break longitudinally, with the road. To prevent this, it is recommended that the old road bed should be thoroughly loosened and then re-rolled with the sides so as to produce a condition as nearly uniform as possible, of the entire road bed beneath the concrete.

It is to be noted that on all the Wayne county concrete roads the distance between the joints is 25′. Mr. Rogers suggests that a somewhat greater distance may be used.

It has been the writer's experience that it is not necessary to place expansion joints so close together as 25′. It will be readily admitted that the fewer the joints, the more desirable the road surface. The following data will perhaps be interesting in this connection, although too meagre to permit us to draw very definite conclusions.

On three pieces of work constructed under the writer's supervision in 1912, totaling 2.3 miles, none of the sections was less than 50′ in length, many of them being 60′ and 75′ and one or two as long as 100′. The number of cracks per mile in these roads at present is: transverse cracks, 9.1; longitudinal cracks, 9.1. As none of the cracks has been classed as a diagonal crack, the total number of cracks per mile is 18.2, but it will be noted in Table No. 1 that the total number of cracks in the 1912 work on the Wayne county roads, using 25-ft. sections, is 19.1. If, therefore, with 50-ft. sections and greater, there are no more cracks per mile than with 25-ft. sections, it is evident that we do not need joints so often as 25′, and when we consider that every joint is really a crack which must be cared for and maintained, it is evident that their reduction is a very substantial gain, both in first cost and subsequent maintenance. However, it will be necessary to have many more data, extending over a much longer time, before it can be definitely concluded how frequent the joints should be; but from the observations that have been made, it seems that the joints may be made further apart than 50′, rather than nearer together.

Before concluding, the subject of the mixture to be used should be touched upon. A concrete proportioned 1:2:3½ is amply rich enough to give the requisite strength required for road service. It is to be noted that this mixture provides sufficient sand to furnish a quantity of mortar equal to approximately 60% of the volume of the coarse aggregate. As was pointed out by the writer in a paper on concrete road construction, presented last year, to the American Road Congress,[1] it is important, if all the aggregate is to be well surrounded with mortar, that with aggregate showing 50% voids, the sand should be in excess of one-half the volume of the coarse aggregate. Actual service has demonstrated the value of proportioning concrete in this manner, rather than using a 1:1½:3 or a 1:2:4 mixture.

Lest a wrong impression should be gained from the emphasis laid upon the defects found in the Wayne county roads, the writer would state in conclusion that the average crack in a concrete road is but a minute affair and is easily and cheaply filled with pitch so as to present to traffic an unbroken road surface. And from a number of personal inspections made of the Wayne county roads, he feels that the Wayne county commissioners have amply justified their adoption of this form of construction and deservedly merit the approval bestowed upon them, not alone by Wayne county citizens but by all who appreciate skillful and painstaking construction of public work.

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[1] Dec., 1912, issue, p. 72

The Protection and Upkeep of Road Equipment*

BY DANIEL J. HAUER†

No matter whether roads are built by contractors or by day labor forces under the direction of engineers, the item of plant and equipment is one of the prominent factors of cost. Inadequate plant means material increase in the cost of construction. Only recently the writer stood watching some road building upon which only a few tools were being used, and most of them were ill-adapted to the work. It was difficult to calculate accurately the exact amount of money that was wasted, due to a lack of road equipment, but it was easily estimated that the cost of construction was increased at least 25%. Likewise, too much plant can make an added cost. Even with the proper plant, handled in an efficient manner, the plant item in road construction is a larger percentage of the total cost of the work than in most other classes of construction. This is due to two causes. First, the plant necessary to build a wagon road is much more expensive than to build, to illustrate, a railroad. With light grading on both, the same equipment will be needed to do the excavation. For the railroad a small concrete mixer may be needed, and some track-laying tools to complete the job. On the other hand, for the wagon road there will be much hauling of road materials, thus wagons and a traction engine will be needed, then road scrapers or graders, and spreading machines, water sprinklers, oil sprinklers, and heating apparatus will be necessary; scarifiers, harrows and rollers must be used, while for concrete culverts and bridges, mixers, derricks, buckets, barrows, and other appliances are called for to do the job in an efficient manner. The writer has constructed a section of a railroad costing about $100,000, with a plant costing only about $5,000, while a contract for less than $50,000 worth of wagon road work took an outfit costing nearly $20,000; 40% of the total cost instead of 5%.

The second reason for the larger cost of plant for wagon road construction is that this class of work is let out in small scattered contracts that are uneconomical from a constructive standpoint. The season, too, for road building in nearly every section of the country is short.

Naturally the life of any machine is dependent upon the use and care given it. The longer the life, the less the annual depreciation, consequently some of the high plant cost can be eliminated from road construction by proper care and upkeep of the equipment, and by selecting the most improved and economical types.

As far is possible the same machines should be used for many different purposes. This can be done in two ways: By trying out machines designed for one particular kind of work, for other kinds, and by adding attachments to machines that thus adapt them to three or four different things.

Keeping Plant Costs Down

To illustrate, a contractor once found by experimenting that a certain kind of road grader would spread crushed stone for macadam at a very much less cost than it could be done by any other known method, at that time. Then a road roller that can be used as a traction engine, with a scarifier attachment, and likewise for operating a stone crusher, or other machines, can be said to be four tools in one; not that it is possible to use it for more than one purpose at a time but in the present method of building roads a roller is used a small portion only of the time, so it is economical to adapt it to as many uses as possible. In this manner the cost of plant, or rather the investment in plant, can be maintained at the minimum.

In like manner, wagons, which are an important factor in road building, should be of the most improved type and adapted as far as possible to all kinds of hauling. So too, with concrete mixers. Some contracts demand a hot mixer as well as one for mixing ordinary concrete. Money is saved when one mixer will answer for both purposes.

Another item in the cost of plant is in the character of the plant purchased. Cheap and poorly made plant means money lost to the contractor in several ways. Delays occur through breakdowns and these are always expensive. Cheaply made tools mean continual repairs and a short life, and are added expense to any job. Only well made tools should be used. A guarantee as to the construction of a machine can and does mean little. It does not mean payment for delays caused by breakdowns, nor for poor work being done. The ability of a manufacturer in swearing that his product is a good one is not a help to a contractor or engineer in getting his work done, nor in showing that the machine in question is well built. The greatest safety is in buying from a firm of recognized responsibility, one of integrity, and one that is so well advertised that it must stand behind its products by putting into them only the best of materials and workmanship. This is the best guarantee possible. This means work done at a low cost. A firm with such a reputation means that thousands of dollars have been spent by it and its customers in obtaining these results. The new customer profits from these past expenditures.

These are all possible factors in plant and equipment, upkeep and maintenance cost. The problem that the contractor and construction engineer must solve in this connection is a very difficult one, owing to the many adverse conditions.

Road work is done in comparatively short stretches, usually in a single season, which varies in length from about 100 days, to 180 days, according to the climatic conditions. A contractor's plant is moved on to a job, and is used along the line of the work, part or all of the time during the season. Much of a contractor's plant is made up of transportation machinery, and even other items of plant are only working in one place for a few days at a time, so that to protect plant while at work on such jobs is very difficult, and in many cases any kind of a protection is a detriment, and a great hindrance to the free movement of the men and teams.

Giving Care to Equipment

All machinery should be protected when it is not being used, and some when it is in use. Boilers at work use much more fuel when not protected. Some kind of a house, built in sections, should always be used to protect boilers. Such sheds can have one side left out, and a canvas curtain used when necessary. If the sides and tops are built in sections they can be hooked together with hooks and rods and staples so as to be rigid enough to stand up against the wind and weather.

Machinery that cannot be protected while at work can be covered with canvas coverings over night, during rainy spells and at such times as they are not in use. Every traction engine and roller should be thus protected. Steam drills and such tools can be covered with a canvas jacket. The machinery part of a concrete mixer can be so protected, and also pumps and other equipment. Heavy water-proofed canvas will be found to be excellent for this purpose, and not only keep the machinery clean from dust and mud, but will likewise prolong the life of the equipment. As the canvas becomes worn from use, it must be re-treated with water-proofing liquids to preserve it.

At the end of the season, with the job finished, the question always arises: "What shall be done with the plant?" To move it from its present place to some central storage point, will mean an added expense to get it onto a new job. If the work on the same road is to be continued the next season the entire outfit may have to be moved back. The plant can be moved to the next job at the minimum cost from the site upon which it last worked. Then the question comes as to how repairs shall be made, and the protection to be given the plant from the winter weather.

Situated away from machine shops, proper overhauling cannot be given to all the plant, but it will be possible to replace many of the worn and broken parts with new ones, tighten up all loose keys and nuts, true up all bearings, and do all repairing that can be done in the open. Then all iron and wood work can be painted. This is a protection not only against the weather, prolonging the life of the plant, but is also a business proposition that pays well, as every one is impressed with machinery that looks well, and paint covers a multitude of defects.

In some localities it is possible to obtain an empty warehouse or barn in which the various machines can be stored while they are idle, or through the winter season. This keeps them entirely out of the weather, and also allows repairs to be made under cover, which means not only quicker, but also cheaper work.

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*Presented at American Road Congress, Detroit, Sept. 29-Oct. 4, 1913.

†Contracting Engineer and Consulting Engineer, N. Y. C.

For winter storage it is also possible to group a number of machines together, and build over and around them a temporary shelter made of cheap boards and single-ply tar paper, which will last a winter season. By using the tar paper, the boards can be spread 6 in. or more apart, both on the sides and roof. Around this temporary shed a ditch should be dug so as to prevent surface water from getting to the machines.

If it is not possible to protect the machines by any of these methods, then the canvas coverings can be resorted to, with fairly good results. These covers should, as far as possible, be shaped to the machine upon which they are to be used. Good and substantial brass eyelets should be fastened in the well bound edges, so that the coverings can be tied tightly to or under the machines, otherwise the wind will flap them loose, soon beating the covering into shreds, as a flag is worn out by the wind, and thus exposing the machine to the weather. Canvas coverings made to fit any machine will always be found useful in protecting machines over night or when not in use for a few days.

Whenever machines are not stored for the winter in buildings, they should be stripped of their brass and glass parts, otherwise these fixtures will be broken or stolen, which means a serious loss. The parts from each machine should be placed in a separate box, nailed up, and properly labeled, the box being stored away for safe keeping. If the machines are stored in a building, it is not necessary to take off parts, as if any one breaks into the building he must go to the trouble of taking off the brass, while if the parts are stored in boxes, the rascals take box and all, giving them much less trouble, and thus assisting them in making a clean sweep of all the brass fixtures.

Spare Parts and Repairs

When a new machine is purchased, there should always be bought at the same time a number of spare parts, which should be kept on hand to be used as needed. No man can build a machine that will not break down in some vital part sooner or later. A breakdown in a construction job means not only a delay, but a waste of money, for even if men can be laid off and not paid, or can be given other work, yet the job, due to the changes made necessary by the breakdown, will not be worked in the most economical manner. It is true that many contractors do keep some spare parts, but they seldom have enough on hand, or the proper ones, due to the fact that as the parts are used to replace broken ones, new ones are not ordered from the factory. Then one of two things occurs: the job is shut down or some part of it, or the machine is worked with the broken part until a new one can be ordered and put in place. This means that the machine is racked by the work it does, doing permanent injury to it.

A good blacksmith shop on the job, equipped with forge for heating heavy steel and with stocks and dies for bolts and pipe, and with good drills and vises, will be found to be a great assistance in the upkeep of road equipment.

Small tools can be repaired promptly in a blacksmith shop. Attention should be given to these as well as to the larger machines. To prevent such tools being lost, they should not only be branded with a die of the contractor's name or initials, but they should likewise be painted with a set of colors, selected by the contractor, to designate his equipment and advertise his business. These colors can be used on the head of some tools, and in most cases on the handles. Tools so marked can be seen at some distance, and thus prevent their being stolen or lost

Many of these suggestions seem useless, or more or less self-evident, but any one who has much to do with road construction knows that tools and machines are scattered along the entire line of a piece of new road construction, just where they were last used, and there they stay, neglected, until they are needed again. Then they are found out of order, and to repair them, frequently new parts must be ordered, some days intervening before such parts arrive. The tool or machine depreciates greatly in value through such treatment, and thus contractors are compelled to figure a heavy plant expense item against every job. The cost of caring for this equipment is much less than the depreciation figured against it from neglect.

Such extra costs mean higher prices for road work, and as there are many thousand miles of roads that need improving, every dollar wasted means less mileage built each year. Both engineers and contractors are interested in obtaining good roads, and they should do everything possible to save money in the construction of roads.

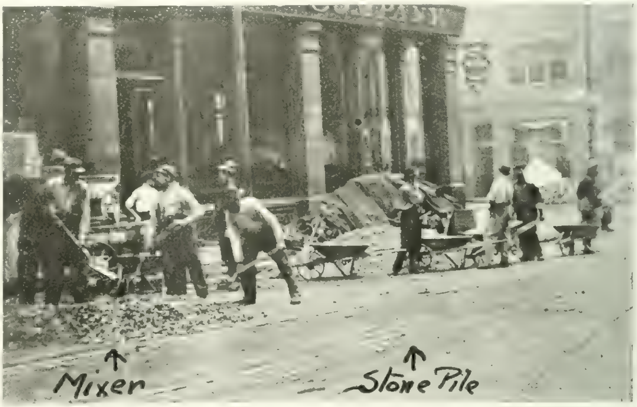

Fig. 2—In This View the Mixer is at the Left, and the Stone Pile Directly in the Center of the Illustration

This shows very well the interruptions of the work due to crossed routes. The photograph was taken from the point indicated in the upper left hand corner of Fig. 1

Short-Cuts on the Job that Save Money

It is usually very easy to criticize, to stand by and look at some work, and say: "How money could be saved if the men were only placed this way," or "They ought to be doing this work with just about half as many men." It is harder, however, to criticize intelligently, to get at root reasons and to point out better methods.

Sometimes, however, it is almost impossible *not* to criticize, and almost any criticism would indicate intelligence, or at least an intelligence superior to that displayed on the work under criticism.

The accompanying sketch (Fig. 1) shows the layout of the gang, equipment and materials, on some work which was noticed recently. The crew were laying concrete base for a wood block pavement, and as we stood on the curb and watched the work, the men seemed all "balled up," and were very evidently interfering with one another badly. The mixer was placed between the stone and the sand, dumped on the street. Eleven men were employed in getting this material into the hoppers of the continuous mixer. Every time a man started across from the stone pile to dump his wheelbarrow of stone beside the mixer, he crossed the trail of the concrete wheelers and then one or the other had to stop and wait. The stone was dumped on the cobblestones beside the mixer and thrown into the hoppers by shovelers. The sand was shoveled directly from the sand pile. The cement was handled by one man, who brought it from a storage pile across the street, untied the sacks and fed the cement hopper. The water was brought from a plug as shown.

The gang handling the work summed up as follows:

Wheeling stone from pile and dumping beside the mixer and shoveling stone and sand into mixer hoppers ....11 men

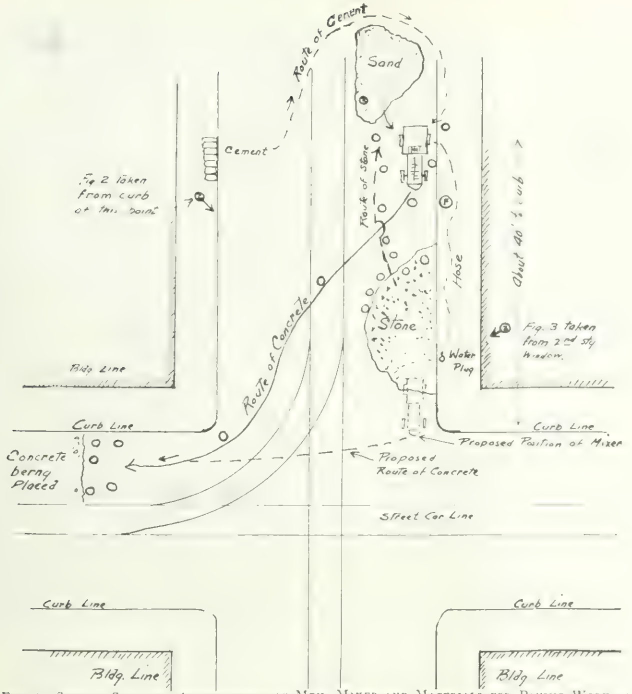

FIG. 1—SKETCH SHOWING ARRANGEMENT OF MEN, MIXER AND MATERIALS FOR PAVING WORK AT A STREET INTERSECTION

Handling cement	1 man
Running and dumping mixer	1 "
Handling concrete as dumped, setting grade stakes, etc.	5 men
Wheeling concrete from mixer to pavement	3 "
Foreman	1 man
	22 men

It was evident at a glance that something was at fault and that the men were not working with any degree of efficiency. At first glance, starting with the materials in their position, it seemed as though all that was necessary was to turn the mixer right around, so as to be able to shovel the stone directly into the mixer hopper.

Further observation, however, showed that the foreman had made his mistake when he placed the mixer between his material piles. This is usually a good plan, but, considering where the concrete had to be placed, in this case did not make for the greatest economy. Because of the street car tracks, it was necessary to keep the mixer parallel and next to the curb. The important thing is to place the mixer where the stone could be shoveled directly into it, and to get the mixer as close as possible to the work.

The position of the mixer shown in dotted lines, and the dotted route 2 show a placing of the mixer which, conservatively, should have saved 6 men. The same men who were shoveling into the hoppers could have still shoveled, but handling the stone directly. Three men could have wheeled the sand satisfactorily; that is, 6 men should have been doing, and doing with less effort, the work which 11 men were doing. Two men could have kept the concrete going away where 3 men were employed before.

It was a light mixer, and 4 men could have rolled it 35' in about 5 min. Foremen sometimes wonder why their costs are high,—why other gangs are doing the same work for less money. The answer is—*brains.*

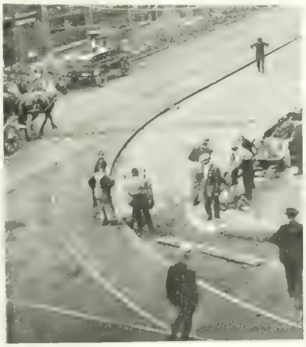

FIG. 2—PLACING A CONCRETE BASE AT A STREET INTERSECTION

This view was taken from the point indicated at the right of Fig. 1

The Strength of Cinder Concrete

In a recent issue of the *Engineering News* Geo. E. Strehan[1] and Harold Perrine[2] present a report of an investigation on the strength of cinder concrete. Following is the general scheme of investigation:

1. Determination of the compressive strength with the elastic and other properties of cinder concrete cast under such working conditions as obtain in actual practice.
2. A study of the behavior of typical cinder concrete slabs under load, as affected by the character and percentage of reinforcement, thickness, span length, age and local conditions, with the view of aiding in theoretical design or establishing a standard loading test.
3. An attempt, through further tests, to recommend specifications tending toward an improvement in the product: i. e., greater density, greater uniformity, etc.

Standard cylinders 16" high and 18" in diameter were used for the physical and elastic tests. These cylinders were molded in galvanized iron forms, which were taken from different buildings in the course of construction in various parts of the city. The mixtures used in the cylinders were identical with those being used in each building at the time the sample was taken as the investigators visited the buildings without any advance notice. Forty specimens in all were taken.

This investigation is now in progress, but the following table presents some of the results already arrived at.

WEIGHT AND COMPRESSIVE STRENGTH OF CINDER CONCRETE AS USED IN [illegible] NEW YORK CITY

([illegible])

Territorial Zone	A	B	B2	C
Mix	1:2:5	1:1:5	1:2:5	1:2:5
[illegible]	107	[illegible]	[illegible]	[illegible]
One-month Test:				
Crushing strength, lb., per sq. in.	[illegible]	[illegible]	[illegible]	[illegible]
Mod. of Elast., lb., per sq. in.	924,600	857,400	1,230,000	1,492,000
Two-month Test:				
Crushing strength, lb., per sq. in.	701	662	1,254	1,035
Mod. of Elast., lb., per sq. in.	1,134,000	1,030,000	1,740,000	1,428,250
Six-month Test:				
Crushing strength, lb., per sq. in.	933	754	1,744	1,478
Mod. of Elast., lb., per sq. in.	971,000	1,050,000	1,348,000	1,276,000

Note: B was hand-mixed; A, B2, and C were machine-mixed. The modulus of elasticity was determined at a point of the elastic curve corresponding to one-fourth the ultimate strength.

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[1] Asst. Engr. of Tests, Bur. of Bldgs., Manhattan Borough, N. Y. C.

[2] Civ. Engr., Dept. Civ. Engrg., Columbia Univ., N. Y. C.

A Complete Structure of Reinforced Concrete in Hollow Tile Forms

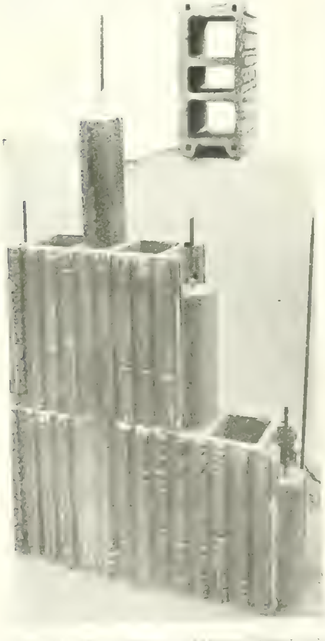
BY FREDERICK SQUIRES*

THIS INTERESTING STORY seems to play up, to a great extent, burnt clay tiles. In the construction described terra cotta tile co-act with concrete very efficiently to produce a permanent fireproof structure. While in the construction described, the tile are of burnt clay, concrete men are able to view this development in a broader light. They realize that construction such as described is really a combination of a pre-made unit and poured concrete. The tile described or an equivalent could be produced in concrete, and we would then have an all concrete construction.

This wall construction, especially the feature of the open sided tile, allowing poured-in-place vertical joists, is interesting. The construction presents features which promise a good deal in future development.

There are two ways of going about the solution of any given problem. One is to produce it full grown by a splendid effort of genius. The second is to build it up part by part, as each difficulty is met and overcome, until the structure stands completed. This article describes how a structure was evolved by the latter method.

When I speak of structure I refer to the working parts of the building, those parts that hold it together and keep out the weather. Upon it and in it may be applied the arts to make it beautiful and the crafts to make it liveable and these will go far toward its success, but most important are the bones and muscles of its carrying parts, its walls, its floors and roofs.



[illegible] Wall Construction

Note [illegible] the concrete joists bear on the tile below. [illegible] Above can be seen one of the tile on end

The way the problem was approached in the work which is the subject of this article was through the use of reinforced concrete for the sinews and hollow tile for permanent forms to shape the concrete and assist it in its work. The man who accomplished the happy result is H. H. Vought, Jr., a New York builder. In a description of the construction of a whole building it is hard to choose at just what point to begin and it may be that a description of the work in the order of actual construction will be the most illuminating way to attack it.

The Wall Construction

After the concrete footings are in place the walls are the first consideration. Probably at no point better than in foundation walls, which not only carry the whole load of the building but resist the thrust of the earth, is the value of this wall construction illustrated. The block used is larger than the standard size as is shown in Fig. 1, and when it occupies its regular upright position in the wall, it contacts with its neighbors by means of its channeled sides, leaving a vertical open form between them which corresponds in position but not in outline with the center flue of the tile in the course above, which breaks joints with it. These vertical cores are designed for reinforcing with steel and grouting with concrete and the fact that the cores do not correspond in shape gives the resulting concrete stud an irregular form and causes it to rest its shoulders on alternate tiles and transfer some of its load to them, putting the whole wall in compression, metal, concrete tile and all. In Fig. 2 it is clearly evident that the exposed stud above does not correspond with the concrete in the tile below. It is also illustrated by a comparison between the outline of the channel and the adjacent opening in the tile. In the same plate (above) is shown a tile set on the wall and seen end on.

It is a particular advantage of this wall construction that the same block serves every purpose in the vertical constructions. Door and window jambs are made with it by chipping off one side of the channel, the remaining one forming with the tile the rabbet for the box. Lintels are constructed in a manner as original as it is efficient. The necessary depth of the concrete is figured and as many of the cores are chipped as is found necessary to accomplish the result. In Fig. 2 the three upper webs were chipped and the bottom web only left intact, making an efficient lintel of great depth. These blocks are set up on the window frame and rods are inserted in the lowest cores. Then very wet concrete is poured into the holes made in the webs and the mass is rammed until it fills the whole lintel. These lintels butt against the vertical walls at each end and are tight forms from all points but on top where the pouring is done. They present, when complete, a good stucco and plaster surface.

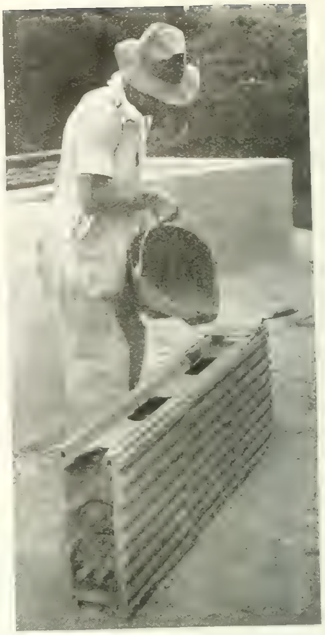


Fig. 2 Pouring Reinforced Concrete Lintel in a Tile Form

Fallacy of Burnable Floors

It is curious that the popular growth of fireproof construction has developed a singular fallacy. Great importance has been placed on wall construction and far less on floor construction, whereas the fire hazard takes proportions in just the other way. A thing burns up. The expression is universal, and it is just as true as it is hackneyed. That's the reason why you have to keep putting burned-off fire brands back on top of your living-room fire. It is the fuel that is in the upward course of the fire that gets burned. The wood burns up. Is it not strange, then, that anyone should build fireproof walls and put fuel floors just where you put fresh wood in your fire place? It is, therefore, particularly gratifying to follow the successful effort to place fire prevention where it best belongs, in the horizontal parts of the structure.

Tile Floor Cores Used

There are two constructive methods shown, both embodying the principle of

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*Arch., N. Y. C.

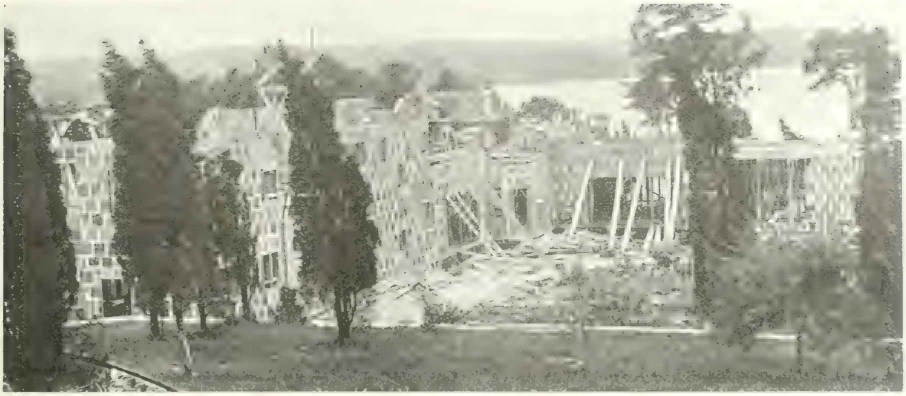


Fig. 3—A General View of the Construction Under Way

a concrete T-beam, parallel beams for short spans and crossing beams for long spans. In each of these, concrete and steel are made the structural elements, but tile is forced to join in the work and in some instances is put into real compression. The general type of floor is probably well known to nearly all readers of Concrete-Cement Age, being no other than the use of tile fillers spaced apart on temporary forms and forming channels between the tiles wherein are placed the reinforcing steel and concrete is poured to the desired depth over the steel. This method was first introduced with rectangular tile fillers, which usually had a top covering of concrete Where this was omitted the beam was sectioned just like a regular wood or iron beam, a very illogical proposition because concrete has little power in tension for which steel is provided and a great deal in compression and should therefore have a top-heavy section, since the volume of steel required is far less than the volume of concrete. Since the top slab is often omitted, a filler was desired which should still properly section the concrete and the inverted T block which will, of course, produce a standing T-beam, was designed. The rectangular outlines of this T were varied by sloping the arms downward since the concrete in compression really follows such an outline. Even when a top slab is required the double T produced by this block is economical. There is an enormous difference in bulk between the concrete required above the neutral axis and that below and it is no exaggeration of the real condition to take care of it with the double T. Such an outline would be far nearer the perfect section for the beam.

Having described this tile section let us see how it was put into practical use. Fig. 4 shows the way the form work is constructed for the parallel beams, and at one corner of the plate are seen the ends of the tile showing how the board completes the enclosure of the beams. Notice the wide spacing of the forms and the unusual size of the tile. The beams thus formed are 2′ on centers. When the concrete is poured to the top of the form it will be seen that the tile fireproofs one section of the floor, while the concrete takes care of the rest. Upstanding ridges on the top of the tile, for the reception of the sleepers, is a later nicety of sonstruction are here shown. They are particularly characteristic of this uncovered T tile, which is most economical without the top covering. In the distant part of this plate will be seen the sloping sided tile just described.

This gives us, for the walls and floors, the backbone of the building, a fire-resisting, permanent and economical structure. Concrete window and door frames and fireproof roof construction are developments under way. The true American home of today can, and should be, fireproof. The home of tomorrow will be.

The American Consul at Port Elizabeth, South Africa, reports that the municipality of Port Elizabeth will be in the market for a considerable quantity of cement to be used in connection with the improvements at the mouth of Baakens River. A channel of concrete is to be made 100′ wide and 1,600′ long.

Climbing Towers with Automobiles

New uses for concrete never cease. The latest is a concrete automobile sightseeing tower, which it is proposed to construct in Denver. It is to be 200′ high and 200′ square at the base and to have encircling it an automobile road up which cars may run with ease, for the miximum grade will be 13%. The distance by the road from bottom to top will be 1,500′, and on top will be a 100-ft. square platform on which the machines can be parked without difficulty. The estimated cost is $100,000.

The tower is elaborate in conception and promises to afford a means whereby automobile tourists may see the mountains from the city of Denver without leaving their cars.

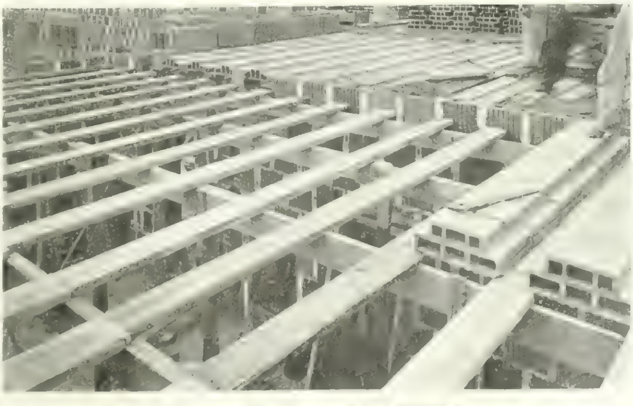
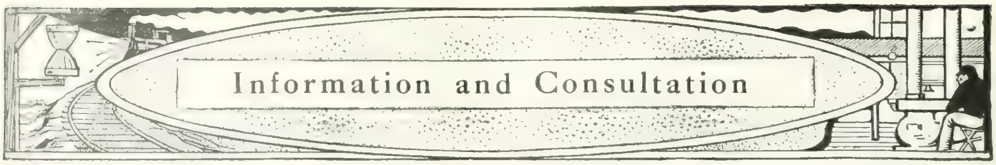


Fig. 4—A [illegible] View [illegible]

The walls [illegible] Is there any [illegible] these tile should not be concrete tile?

In immediate foreground is shown in detail the centering required. In the [illegible] shown [illegible]



Information and Consultation

We learn best by doing. This department is a place of exchange between those men who know from specialized experience and those men who want to know. The Discussions are specific and direct. In the following pages the topical heads show the many lines of activity in the concrete field which are covered. Questions and Discussions are cordially invited

321. Using Paraffin Gasoline Solution to Waterproof Concrete

"Will you tell me what grade of paraffin is employed for waterproofing purposes as mentioned in the articles page 87, of the Feb., 1913, issue? Will it dissolve like that in gasoline or is it better to warm it a little, and what proportions of gasoline and paraffin must be employed? What proportions for linseed oil must be used? I have tried linseed oil but without very good results. I believe paraffin will be preferable. Is the result permanent?"

321. Discussion by Ign. Bilodeau*

In my experience with this problem I used pure refined paraffin, dissolved in gasoline, using just enough gasoline so that it will flow when the temperature is at about 55° or 60°. With this preparation I painted a block severely exposed to the weather in a corner of my factory. This block was made on a Palmer machine about five years ago, using a 1:3 mix for the face.

The block that was painted has a plain face and near it, somewhat less exposed, is a rock-face block.

When I painted these block three months ago with the above preparation they were perfectly waterproof, but recently I went out to test them and threw some water on both block. The plain block showed practically the same absorption as the other block in the wall, while the rock-faced block, which is a little less exposed to the weather, is still waterproof, but not so much as before.

Perhaps if I had applied two coats of this gasoline-paraffin solution the results might have been better.

* * *

325. Cinder Foundation in Sidewalk Construction

"We should be glad to hear from authoritative sources some expressions of opinion relative to comparative merits of concrete sidewalks with and without drainage foundation, using as a basis for comparison, a 4-in. thick slab of concrete laid on a cinder cushion 8" in thickness, or a 4-in. thick slab of concrete laid on a solid dirt bottom, without any cinders or other provision for drainage. Our own experience has been that the latter method is equally as good as the former, if not a shade better, other things being equal as to material and workmanship, but we should like some expressions from engineers and others in the trade as to which of the methods, if any, is either considered standard, or tending to become so.

"In this connection, we should like to know whether or not it is usual in the case of the cinder foundation being required, to demand that the cinders be passed through a ¼-in. screen, assuming that the cinders are a good grade of factory cinders, with the usual amount of fine material, but free from waste or rubbish. We have been in the habit of using the cinders as they come to us, but we are now asked to screen them through a ¼-in. screen, on the engineer's interpretation of the clause 'clean steam cinders' used in the specifications.

"Is the specification referred to not unusually strict, and arbitrary in general, and if required to be lived up to in its entirety, would it not make the cost of sidewalks laid in strict conformity with it a very expensive, not to say an almost prohibitive, job?

"We should be obliged for your opinion relative to the following terms from the sidewalk ordinance under which we are now working:

'clean steam cinders'

'clean, sharp, screened sand' (used in the concrete)

'covering and keeping moist for three days'

"We are trying to have a change made in the specifications which will allow of good work for less money than is entailed in laying the sidewalks strictly according to sample specification and your good advices, and those of correspondents will be appreciated."

325. Discussion by S. W. Hoffman*

One of your correspondents in your Aug., 1913, issue very earnestly solicits comments from those who have had experience in laying concrete sidewalks with cinders. I thought it may be interesting for him and some of your other readers of Concrete-Cement Age to hear from one who has had about 30 years' experience in laying concrete sidewalks.

To lay a concrete sidewalk, that I felt safe in guaranteeing for 5 years to 10 years, I decided years ago that 8" of clean cinder cushion was the minimum to be used, 3½" of good wet concrete for base, sand mortar not to be poorer than 1:3; top dressing ½" thick; mortar or mixture not poorer than 1:2. Sections should be cut entirely through, making each block independent. Blocks should not be over 4 ft. square for 4-in. work.

Occasionally I have observed concrete sidewalks laid as above described raise 2" in hard, freezing weather, and then settle back to their original positions. If they had not had good cinder cushions there might have been unequal expansion, and danger of cracks.

I have noticed recently large stretches of 4-in. concrete sidewalks, laid directly on the ground, that have passed the cold winter of 1911 and 1912 and remained perfect. And consequently there are very few cinders being used in our town. Sidewalk men have become very bold since such good results have been obtained without cinders, withstanding the very severe winter of 1911 and 1912. But there is a condition existent that many do not think of. In the winter in question it froze up very dry to start with, thus preventing any subsequent rains from penetrating under the walks. Had it rained considerably, moistening the earth at the edge and under the walks previous to the freeze-up, the expansion might have been considerably more and uneven, and there would be a different story to tell.

Of course, where the ground is not natural, but has been filled, the foundation could not be uniform, and judgment would have to be used in preparing it so that there would not be any settlement.

In regard to screening steam cinders, I do not think this is necessary, if you get the average run as they come from the furnace. But, if they are so full of dust that the foundation is not sufficiently porous, the dust ought to be screened out.

I have walks that have been laid from 20 years to 30 years, cinders used just as they came from the furnace, and they still remain in perfect condition.

* * *

337. Silicate of Soda Paint

"Some time ago the following formula was given to us to make a paint for con-

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*Quebec, P. Q.

*Zanesville, O.

crete work, claiming that it could be washed and scrubbed:

Silicate of Soda—N grade....1 gal.
Oxide of zinc ground in water..1 lb.
Flour marble enough to make the whole to the consistency of paint.

We have followed the directions and it gives a beautiful white, but it comes off and peels. We then reduced the silicate to about 20° Beaume and it does not entirely come off. When you rub it with the finger, once dried, some powder comes off.

Will you please tell me the cause of that trouble and the remedy?

If you know of any work on silicate of soda paints for concrete, will you please advise me the name of the work, that of the firm who sells it, and if possible, the price?"

337. DISCUSSION BY C. S. NEAL*

The use of soluble silicate of soda or water glass is quite old. It is based on the supposition that this material is soluble in very hot water only, and is not affected by cold water, so that it can be dissolved into a solution and painted and when the water has evaporated there is a film left that cannot be washed off by the rain.

We have never seen in practice cases in which the silicate has been able to withstand the action of rain for any length of time. The quick chalking might have been caused by adding too much water, but the silicate of soda is never a strong enough binder to overcome entirely the tendency toward chalking. Nor is it elastic enough to stand the expansion and contraction, due both to swelling caused by moisture and expansion by heat.

Along these lines, the U. S. Govt. standard lighthouse whitewash formula would, we think, be better or a formula which calls for a small quantity of casein for a binder.[1]

We think that most of the paint manufacturers, at one time or another, have tried to use silicate of soda paints, with unsatisfactory results, but we do not know at present of any of the large houses that put out such an article and stand behind it.

They probably all have formulas and would be willing to make a silicate of soda paint on their own formula or upon the one mentioned above, but we think you will find that any brand of high grade paint will give more satisfaction. We doubt that any silicate of soda paints will ever answer the purpose referred to above.

* * *

328. Lye and Alum Waterproofing

"Will concentrated lye and alum make a waterproofing compound?"

328. EDITORIAL DISCUSSION

In *Cement Age* for May, 1911, J. R. Bayliss, then at Palestine, Tex., described the method of waterproofing roofs with lye and alum. The article follows:

While in charge of the construction of a hydro-electric water and light plant for the city of Lawrenceburg, Tenn., several years ago, we used reinforced concrete for the construction of the roofs of the power house and pumping station. These buildings have been in use nearly three years without any leaks through the roofs. The plant consists of a concrete dam, tunnel through rock, power house with electric generator and turbines, two reinforced concrete pipes from the tunnel to the turbines, and an electric pumping station half way between the power house and town. The pumping station is a small concrete building containing the pump and motor, and is built over a large spring.

Both buildings are of the ordinary type of concrete construction, with roofs and floors of reinforced concrete. The roof on the pumping station is 6" thick; 5½" of 1:2:4 concrete, and ½" of 1:2 mortar finish. The concrete was placed in a plastic condition and tamped lightly into place to insure no voids being left. The mortar finish was applied immediately after the concrete, and finished off smooth like a sidewalk as soon as possible, which was about the time it began to take its initial set.

A lye and alum solution was used in the mortar finish. One lb. of concentrated lye and 5 lbs. of alum were mixed in 2 gals. of water. One part of this solution to about 30 parts of water was used. When the mortar finish was beginning to take its permanent set it was painted with two coats of the solution mixed with neat cement in about the proportion of 1 pint of solution to 2 lbs. of cement.

The same process was used in the construction of the roof on the power house. These roofs have been in use nearly three years and show no hair cracks nor leaks.

There are two reinforced concrete pipes, 4' in diameter and 6" thick, leading from the tunnel to the turbines. One of them was waterproofed on the inside, in the same manner as the roofs, except that the mortar finish was applied after the forms were removed. The other one was plastered on the inside with ½" of 1:2 cement mortar without using any of the waterproofing compound. Both pipes are under a head of about 12 ft. of water, and neither one has shown any signs of leakage. I doubt that the lye and alum solution was of as much importance in making the concrete impermeable as care in mixing and placing it. These buildings were designed by Walter G. Kirkpatrick, Jackson, Miss.

328. DISCUSSION BY JOHN R. BAYLISS* [This discussion is contained in a letter received from Mr. Bayliss under date of Oct. 6, 1913.—Editors.]

Last summer I was in Lawrenceburg and examined these roofs. They were in perfect condition and showed no signs of leakage except at a few points where joints were made. These were easily stopped, but the condition shows that extreme care must be taken in making joints. I believe that expansion joints should be about 20 ft. apart, for the variations in temperature will cause cracks in concrete, even though it is heavily reinforced, if the joints are too far apart.

I had occasion to construct another roof on a small pumping station at Jellico, Tenn., about a year ago, using the same method of waterproofing. It has a slope of 1" to 12", and has shown no signs of leakage.

There is one omission in the article of May, 1911, that might need further explanation. It should be emphasized that the lye and alum solution was used in the concrete as well as in the mortar finish on the roof of the power house and feeder pipes, except in the mortar finish of one of the feeder pipes, as stated.

* * *

331. Cement Grout in Oil Shafts

"In this country there are thousands of oil wells. The formations are varied, mostly shale and clay, with strata of lime. We now propose sinking wells where the principal formation is soil and clay. In many places no rock of any character is encountered at all, even at 1,000 ft. depth. The difficulty is that after, say 100 ft., the walls above where the tools are working will give way and cave onto the tools. Usually the water used with the action of the tools leaves a smooth mud wall which will stand until the well is finished and the casing is inserted, or until either sand or rock is struck and the casing placed in to that depth. Then the smaller tools, etc., work inside this casing to the lower depth.

Now, what we are seeking information on is:

1st—Can we make a thin cement mixture and use instead of water alone? Would the cement be forced into the wall sufficiently so that when the bailer lifts out the product of mud and cement, the cement left on the wall would set sufficiently to stand while the bailer was lifted out, emptied, refilled and returned and proceeded to go another screw length in depth, about 6 ft.?

2nd—What mixture would you make? What is the probable quickest time possible for it to set? Is any special make of cement necessary? Do you think it would penetrate the walls of the hole (6" at bottom to 13" at the top) to hold a soft or caving foundation? So as to make the best possible time in drilling, the time consumed in drilling a 6 ft. scew and bailing out would require from 20 min. to 30 min. Could the cement be made so as to set in that time?"

331. DISCUSSION BY VAN H. MANNING*

Relative to the use of cement grout in oil shafts, the engineer in charge of such investigations advises that it is very doubtful that it would be possible to get a coating of cement on the wall of the hole of sufficient stability to be of any use. Where cement is used to reinforce caving ground, some method of forcing the cement into place is necessary and sufficient time must be allowed to enable the cement to set thoroughly.

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*Factory Mgr. Acme White Lead & Color Wks., Detroit.

[1] The reader is referred to the formula of the U. S. Government for lighthouse white-wash, published under item 307 in the May 1913, and Oct. 1913, issues

*Birmingham, Ala.

*Asst. to the Director, Bureau of Mines, Washington, D. C.

If cement mortar having the initial set within half an hour be simply smeared on the wall and drilling tools run as soon as the bailer is withdrawn it is not likely that much of the cement will penetrate the wall or that it will fail to be dislodged while still green by the drilling tools.

* * *

333. Permanence of Concrete Silos

"In talking with a large stockman in this vicinity who is considering the construction of several silos, he has advanced the objection to concrete construction on the grounds that there is a chemical reaction between the concrete and ensilage which spoils the latter for a distance from the wall.

"He also states that he has heard that the acid in the ensilage has a deteriorating action on the concrete which will eventually cause the concrete to crumble. Can you give me any information in regard to this?"

333. Discussion by C. M. Long*

Regarding the effect of ensilage on concrete silos, I have never seen any chemical effect of the ensilage in any concrete silo that I have ever seen and I have seen perhaps a hundred silos of various kinds, such as monolithic wall, concrete block and concrete stave, metal lath plastered and the plastered silo. If the ensilage should produce an acid strong enough to act upon the cement it would certainly be a very dangerous substance to put into the stomach of any living animal. I have seen a few silos of the concrete block type, where the ensilage spoiled around the edges. This is due to the fact that in making some block it is necessary to use a very dry mix and this makes the concrete porous, which causes absorption of the moisture from the ensilage and causes it to spoil. When these silos are plastered with a rich coat of cement the ensilage will no longer be lost in this way. In the later days in monolithic silos, where a very wet "batch" is used, I have never seen any spoiling of the feed. If the structure is properly put up it will keep the feed as well as any thing I have ever seen.

Proper Filling Necessary

Much of the lost ensilage attributed to the structure is merely due to the faulty method of filling the silo. Unless the ensilage is packed thoroughly around the edges, sufficient air will be retained to produce bad ensilage. This will happen, regardless of the kind of silo used.

I have known a tar coating preparation as well as a rich cement preparation to be used on stave or cement block silos to make the walls impervious. We are recommending the solid wall cement silo unhesitatingly and a great number have been built in this vicinity. They are giving uniform satisfaction.

335. Concrete Slabs for Filter Work

"I have occasion to make some cement slabs about 18 ins. x 24 ins. sq. and as thin as possible. These should stand ordinary handling and yet be porous enough for a filter.

I don't want slabs thicker than ½" or ¾". I want as light, thin and strong slabs as will stand ordinary handling.

I have thought that a proportion of sawdust might make it porous enough. What information can you give me?"

335. Discussion by W. E. Wagner*

In regard to this problem of concrete filter slabs, I am afraid that the inquirer is in for a disappointment, for he calls for strength and weakness in the same article. To allow the percolation of water through concrete, the latter must be porous, and I would suggest his trying suitably screened cinders with very little sand. I think, also, a porous concrete could be obtained with sawdust, by afterward subjecting the slabs to heat sufficient to burn out the sawdust, but I am extremely doubtful of the possibility of slabs being made porous and at the same time retain sufficient strength to stand much handling, if only ½" or ¾" thick, especially as any reinforcement would soon rust away, though if the reinforcement were galvanized it would retard the destruction of the steel.

* * *

345. Chimney Construction in Monolithic Cottages

"I am planning to build several poured concrete houses and want to know the best way of building concrete chimneys. What advice can you give me?"

345. Discussion by P. H. Bosworth‡

Regarding the subject of concrete chimneys in poured concrete buildings, I fail to see any difficulties to be met or overcome by anybody who has progressed far enough to erect a satisfactory form to enclose the walls of the building itself. These forms will naturally take care of the outside of the chimney; the smoke flue may be formed with wood, terra cotta or black iron stove pipe. Terra cotta is the best, as it forms a protective lining against the heat from the fireplace. Common black iron stove pipe is the cheapest material to use to form the smoke flue; but it will burn and rust out in time.

A wood core forms the poorest flue, as it is almost impossible to get the core out without injuring the concrete work. If it is burned out the heat will invariably crack the concrete. A collapsible wooden or metal form may be made to form the firebox or a patent grate may be set in place and the concrete poured around it, fastening it in place and saving the necessity of making a form. Carrying the possibilities still further, molds of either glue or plaster may be made and set in place that will form the mantelpiece and the chimney breast at the same time.

348. Casein as a Waterproofing Material.

"Can you advise us whether or not casein, made from milk, is on the market as a commercial commodity? We are interested in the possibility of its use in the preparation of waterproof coatings for concrete."

348. Discussion by Prof. E. E. Ware*

The protection of concrete structures demands that the coating used be impervious to water, as it has been shown quite definitely (*Eng. News*, Vol. 66—A. H. White) that the disintegration of concrete under weather conditions is largely due to the expansion and contraction caused by alternate wetting and drying.

It is the opinion of the writer that casein preparations do not serve this purpose so well as do some of the other more waterproof materials, although from a decorative standpoint they do well enough to make their use permissable when the danger from expansion and contraction is at a minimum, and the cost of the better materials prohibits their use.

* * *

349. Cost of Operating Salamanders.

"Can you tell us how much it costs to operate salamanders when running concrete work in cold weather? This question naturally resolves itself into the size of the salamander, the price of the fuel, and the amount the salamander is crowded for heat. We shall appreciate some first-hand information on this."

349. Discussion by W. P. Anderson†

In reference to cost of salamanders in protecting concrete in cold weather, not only is it necessary to enclose the form work but to heat the concrete material before mixing. In a large job which we had in Detroit last winter, we kept a separate record of the cost for protection which included the labor cost in placing pipe, etc., necessary for heating our material, labor of placing burlap around the outside of building between the column forms, and the labor of attending the salamanders.

It was a very mild winter for Detroit and of course we did not have to protect all the concrete in the building, as early in April it got warm enough to discontinue most of the protection work. We would say, however, that we concreted between 3,000 cu. yds. and 4,000 cu. yds. on which protection was required and the labor cost of this protection came to about 18c a cu. yd.; the material cost, including coke, curtains, straw and incidentals, amounted to about 20c to 25c per yd. Of course, costs on protection vary greatly in accordance with cost of fuel, size and shape of building and the average temperature. In connection with the use of salamanders we also burn up some of the scrap lumber left over from the form work. It is questionable, however, that this is any creaper than coke on a large job, as the labor of atttending the salamanders where coke is used is much less than where wood is used.

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*[illegible]

*[illegible] Ont.

‡Mgr. Bosworth Construction Co., San Francisco, Cal.

*Univ. of Mich., Ann Arbor, Mich.

†Pres. Ferro Concrete Const. Co., Cincinnati

[1] For discussion of this question, see page [illegible]

349. Discussion by James Bentley*

The weather conditions, the conditions of the work, price of fuel, type of salamanders and the men in charge, all have such a large bearing on the cost that it is nearly impossible to set any figures that have any value.

We find that the large, flat salamanders with a cast iron grate in the bottom and plenty of room for draught below are the best type. The best grade of coke is none too good to burn in them.

We find that the cost of operating one of these for 24 hrs. is anywhere from 50 cts. to $1.50, depending upon a thousand different conditions.

* * *

350. Stone Dust as Concrete Material.

"I am planning to build a cellar 31' x 47' and 7' high, using stone masonry. A new state road just put in near here and at the stone crusher is a big pile of the dust or finely ground stone, which can be bought cheap. Sand is hard to get and poor when it is found. Can I use this stone just with Portland cement to make a mortar?"

352. Discussion by Albert Moyer†

Stone dust can be used for concrete instead of sand, with excellent results The house I built in South Orange, N. J., in 1907, which is of exposed selected aggregates, the aggregates exposed by means of scrubbing the surface while the concrete was green, is monolithic concrete in which no sand whatever was used. Trap rock screenings were used. All that passed through a ¼-in. mesh was figured as sand in proportioning these aggregates.

I have seen a briquette made in a laboratory in Boston, mixed 1:2½, using Portland cement and stone screenings passing through a ¼-in. mesh, which at the end of two years' time, when broken, showed a tensile strength of a trifle over 1,000 lbs. per sq. in.

In using stone screenings, the screenings should be from hard stone, such as trap rock, granite or very hard limestone. They should be graduated in size of particles with not too much dust present.

The writer analyzed a sample of trap rock from the quarries at Snake Hill, N. J., and sample all passed through a ¼-in. mesh. I took a total of 42 15/64 oz. and passed it through the sieves with the following result:

Collected on No. 10 sieve........	$20\frac{19}{64}$
Collected on No. 20 sieve........	$9\frac{40}{64}$
Collected on No. 30 sieve........	$3\frac{47}{64}$
Collected on No. 50 sieve........	$3\frac{32}{64}$
Passing through No. 50 sieve.....	$5\frac{5}{64}$

Making the test for voids, 100 c. c. of these trap rock screenings were placed in 100 c. c. of water, placed gradually so that the air was expelled, and the water rose to 166 c. c. This is equivalent to 34% voids, a percentage lower than is usual in some of the best sands. This would allow a safe proportion of 1 part of Portland cement, 2¾ parts screenings.

Proportioning concrete, using these screenings—suppose a cu. ft. of crushed trap rock all collected on a ¼-in. mesh and all passing through a 1½-in. mesh, weighed 110 lbs. per cu. ft. There would be 39% voids and this would indicate a proportion in concrete of 1:2¾:7 to bring about maximum density.

Contrary to theory, but a fact which has often been noted, concrete made of stone screenings instead of sand will settle into a denser mass, the texture will apparently be closer, and such a concrete will allow the removal of forms at a very much earlier period than if sand were used.

I think it perfectly safe to use these screenings if made from hard stone, if not over 25% is passed through a No. 50 sieve. It is perfectly correct premise that even the smallest particle of dust is as strong in proportion as the stone from which it came. The graduation in size of particles is what is desired and therefore a limit as to the number of fine particles present should be in the specifications because all the fine particles may be of the same diameter and not graduated in size; 25% of fine particles, if compared with tests on sand, is a perfectly correct proposition.

Cow Bay sand, which is used almost exclusively around New York City, contains usually from 20% to 25% fine particles; that is all which would pass through a No. 50 sieve.

Rockaway sand, a beach sand found on the south shore of Long Island, contains approximately 65% of particles which will pass through a No. 50 sieve, although this very same sand, when mixed up into briquettes in the proportions of 1 part cement and 2½ parts Rockaway sand, gives a tensile strength at 7 das. of 255 lbs. per sq. in. and at 28 das., 334 lbs.

I have no extended tests on briquettes made with stone screenings, but am firmly convinced that if such tests were made and the voids properly calculated, even though there were present 30% of particles which have passed through a No. 50 sieve, higher tensile strains would be obtained at 28 das. than with even the best of sands.

* * *

351. Light and Dark Pavement Surfaces

"There is still some prejudice in our locality against concrete sidewalks on account of the glare. The same argument has been brought against concrete for pavement work. Concrete, as it dries, cures and ages becomes, of course, a rather grayish white and when people are used to darker pavement materials it does seem to have a glare. We know that this glare could be eliminated by the use of lamp-black or other coloring materials. What we want to know now is whether or not a darkened pavement is any cooler than one of the ordinary concrete color. Have any experiments been made along this line?"

351. Discussion by Clark R. Mandigo*

It is my opinion that a darkened concrete pavement would be cooler than a lighter colored concrete pavement. Of course, it is a well known principle that certain colors absorb heat and others reflect the heat, white being the greatest reflector and black the greatest absorbent. This would make the darkened pavement probably have a slightly higher internal temperature, but it is the white glaring pavement which reflects the heat of the sun at the hottest part of the day, which is the least desirable from a color standpoint.

It is my opinion, therefore, although I have laid no specially colored pavement, that a dark gray color would be much better than the ordinary white concrete. It also has the advantage of being less trying to the eyes. Other people to whom I have talked on this subject have agreed with this.

351. Discussion by C. W. Boynton†

A good deal of interest is at present being manifested in the question you raise as to the advisability of darkening the ordinary concrete pavement in order to lessen the glare of reflection. There is undoubtedly a happy medium between an absolutely white surface and one which is black. A white surface reflects all of the light and is undoubtedly injurious to the eyes; a black surface, while ideal in its absence of light reflection, nevertheless absorbs light and gives it off as heat. Part of this radiation takes place during the day, but the most objectionable feature is its continuance after sundown, which keeps the atmosphere above the street in a heated condition for some hours. A happy medium is probably a gray surface, which can be made by using lamp-black, or some similar coloring material in the concrete. The requisite amount should not be more than about 1 lb. of lampblack to a sack of cement.

* * *

352. Avoiding Air Bubbles In Casting Concrete

"In casting flower boxes, laundry trays, balusters, etc., using a very wet concrete mixture, what should be done to avoid air bubbles in the product? These bubbles give a great deal of trouble because it is so hard to finish them up and make a neat job."

352. Discussion by H. P. Warner**

For the elimination of air bubbles in products made in wooden molds with a very wet mixture, we have a gyratory process under which the material is poured in the molds while placed on a large platform which is kept constantly in vibration. This platform has a vertical rise and fall of approximately 6 in. and is driven by a 10-h. p. motor. By this method we find very few air bubbles resulting in the finished product. If the pattern is rapped sharply with a hammer immediately upon being filled the results are very similar, on a smaller scale. Small air holes can be filled by rubbing the surfaces with a neat cement after the products are removed from the molds. In our regular process, however, of sand molding we have practically no trouble in this connection. The sand absorbs the excess of water and air and the result is a very dense stone entirely free from this defect.

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*Vice-Pres. A. Bentley & Sons Co., Toledo, O.

†Mgr. Sales Dept. Vulcanite Portland Cement Co., N. Y. C.

*Asst. City Engineer, Kansas City, Mo.

†Information Bureau, Universal Portland Cement Co.

**Pres. Onondaga Litholite Co., Syracuse, N. Y.

352. Discussion by C. W. Boynton*

Although it is rather difficult to avoid the formation of these air pockets in this case, by using a wet but not "sloppy" mixture, a careful working of the concrete and a jogging or tapping of the forms will tend to eliminate these bubbles. This treatment will tend thoroughly to surround the larger material with the finer and to fill up the air spaces. However, if some of these irregularities still remain, it is possible that the surface of the work can be smoothed up under these conditions by applying a thin grout, consisting of cement and sand, immediately after the removal of the forms. This grout should be well rubbed in by the use of a brick of carborundum, emery, concrete or soft natural stone, after which the work should be washed down with clean water.

350. Discussion by Albert Moyer†

In casting flower boxes, etc., using a very wet mixture, air bubbles can be avoided by jarring the mold, tapping it as the mixture is placed, placing a small amount at a time, and also by running a steel rod along the sides, working it up and down, which is called puddling.

The mixture, however, should not be too wet. The proper consistency is that in which, when puddled, very little water arises to the surface. It should be of a rather jelly-like consistency, and placing a little at a time should solve the problem of air bubbles.

The proportion of the mixture and the size of the aggregates have something to do with this matter. The aggregates should not be over ½-in. sizes, that is, all which will pass through a ¾-in. mesh, all collected on a ¼-in. mesh. That which passes through a ¼-in. mesh must be figured as sand.

If the sand is of very good quality and graduated in size of particles so as to make a dense mixture, the proportions used may be 1 :2 :4. If the sand is of ordinary quality only, the proportions used should be 1 :1½ :3. This kind of work should be made with rich concrete. After placing in the mold, as soon as the concrete has stiffened up sufficiently, the core should be removed. Then after 12 hrs., fill the box up with water and let it remain that way for several days.

You will thus avoid cracks due to shrinkage. The exterior should be rubbed off with a carborundum stone, sand blast, or tooled the same as natural stone. This will avoid the formation of hair cracks, or crazing.

353. Concrete Tanks In Vinegar Manufacture

"I should like information as to the use of concrete tanks in the manufacture of vinegar. It is proposed to make vinegar in large quantities and to use concrete tanks throughout the process. The question is, will the vinegar ferment properly in concrete tanks and will the acid formed affect the concrete?"

353. Discussion by R. A. Plumb*

While we have never had opportunity to make a practical test of this application of concrete, yet we are of the opinion that it would not be a success. While there might be more or less question with regard to the action of the bacteria, causing the fermentation in the presence of more or less alkali that would leach out of the concrete, yet we believe a more important consideration is the protection against the solution and disintegrating action of the acetic acid which is formed.

As you know, the vinegar is formed by the action of a group of bacteria or micro-organisms which oxidize the carbohydrates to alcohol and then to an aldehyde, and ultimately into acetic acid. While acetic acid is much weaker in its acidic strength than our more common mineral acids, such as hydrochloric, nitric, sulphuric, etc., yet we would anticipate that it would manifest a very active and energetic solution action on concrete, due to the natural energy with which calcium salts unite with acetic acid to form the soluble acetates.

We would suggest that you conduct a few simple experiments by preparing a small concrete disk, and after they have sufficiently hardened and set, fill them with acetic acid and observe the exact action.

We certainly would not recommend that you undertake the actual construction of concrete tanks for the fermentation of vinegar until you have ascertained the actual effect of the presence of alkali in the water on the activity of the micro-organisms causing the fermentation, and also the extent to which the acetic acid formed will affect and disintegrate the concrete. The information which we stated above is more or less theoretical, but we feel quite certain that you will find it is fully confirmed in actual practical test.

353. Discussion by Ernest Ashton†

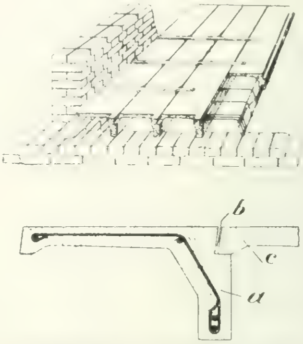
We cannot endorse the use of reinforced concrete tanks for storage of vinegar without some protection.

Portland cement is entirely soluble in acetic acid, which is formed during the fermenting and manufacture of vinegar.

In a series of experiments made it has been found that by coating Portland cement concrete tanks with a bituminous compound, that no disintegration or deleterious effects have been noted. Under these conditions we can advocate the use of concrete tanks to which the above coating has been applied, guaranteeing that the results will be perfectly satisfactory.

An Angle Floor Beam Detail

In the last few years there have been many interesting developments in floor construction. The accompanying sketch, taken from a recent issue of *Tonindustric-Zeitung*, shows an interesting floor beam construction which seems to promise a good deal. It is not possible, at this time, to give very much detailed information on this. The general arrangement is shown very plainly. This system is being developed by Morel & Co., Zurich, Switzerland.



Sketch Showing Arrangement of Floor Beam Developed in Switzerland

Heating Industrial Cars for Cold Weather Concrete

There are many interesting field kinks which have been developed by practical men which make for better accomplishments in the field. In handling concrete work in cold weather we usually heat the sand, aggregate and water if necessary and use various saline solutions to keep the water from freezing. As an additional precaution some contractors on a large piece of work last winter developed an effective method of conserving all the heat possible. They were handling concrete with industrial cars and at the point where the concrete was placed a man was stationed with a supply of gasoline and a dipper. After the car was dumped out he "swashed around" the inside of the car with a dipper full of gasoline and threw a match in. The amount was so gauged that it would continue to burn on the entire return trip with the consequence that the warm concrete out of the mixer, instead of being dumped into a cold car, was dumped into a car already warmed.

Consultation

348. Further Discussion (Editorial)

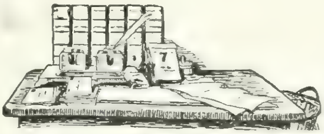
Since the discussion on p. 226 was prepared, we have been advised that casein is an established product in the paint and oil market. In the paint industry casein is largely used in making kalsomine. There are several firms manufacturing it.

Cement Co.

†Mgr. Sales Dept. Vulcanite Portland Cement Co., N. Y. C.

*Chemical Engineer, Lehigh Portland Cement Co.

†Trus-Con Laboratories, Detroit



Correspondence

Another of the many instances where concrete has successfully resisted fire,—building development in the Philippines,—some advice from aggressive plant managers on methods of selling synthetic stone,—some more field kinks from the Philippines are items that make up Correspondence this month. These letters are really short articles, crisp and to the point.

Concrete Bins for Granite Crystals Resist Fire

CONCRETE-CEMENT AGE readers will be interested in an account of the fire at our plant through which we have recently passed. Our 10 large reinforced concrete bins contained our stock of Granite Crystals, and in a fire which absolutely destroyed all our plant these bins came through unscathed. The fire occurred Aug. 4, 1913, and was one of the largest in the history of Crown Point. At some points the heat was so intense as to melt the large flywheels of one of our machines and yet a few hours after the fire was at its height it was possible to put a hand on the surface of the concrete bins where the fire had been hottest.

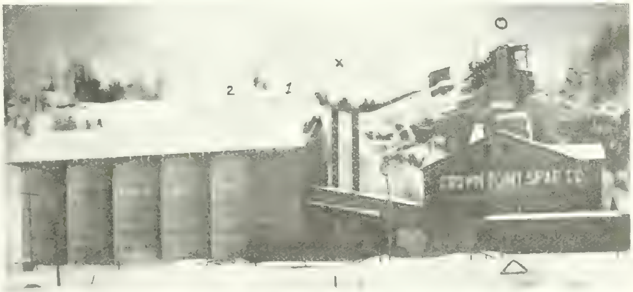


FIG. 1—GENERAL VIEW OF THE CROWN POINT SPAR CO., CROWN POINT, N. Y.
The cipher is used to indicate the points which are shown in Fig. [illegible]

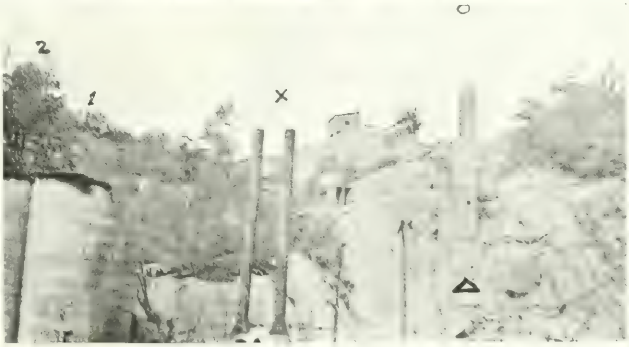


FIG. 2—THE PLANT OF THE CROWN POINT SPAR CO., AFTER THE FIRE OF AUGUST 4, 1913

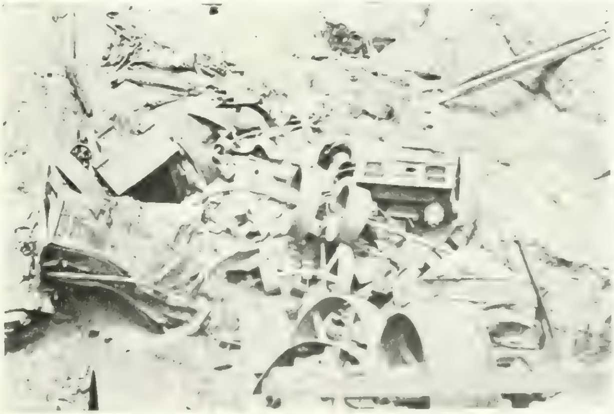


FIG. 4—SOME OF THE MACHINERY AFTER THE FIRE

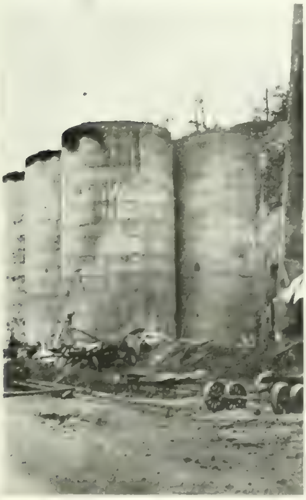


FIG. 3—DETAIL VIEW OF THE CONCRETE BINS AFTER THE FIRE

Fig. 1 shows our plant when in operation and before it was destroyed by fire. Fig. 2 was taken after the fire and I have used a simple cipher to show relative points. After the fire there was not left a piece of wood as large as your arm. In the foreground of Fig. 3 is shown what was left of a freight car which was loaded with granite crystals. The tracks are left and the granite crystals were all deposited on the tracks just where they dropped. This car was all loaded for shipment to the Zagelmeyer Cast Stone Co., at Detroit, who were wiring for their car. Drawing on the stock in the concrete bins which were not touched by the fire, we were able to get the material loaded and had a new car rolling west within five days after the fire, and since the fire we have been shipping without interruption. Fig. 4 shows how some of the heavy machinery was dropped from the top of the cliff, as the supports were burned out from under and totally destroyed.

The bins were built in midwinter two years ago and to date have been very satisfactory. Fig. 5 gives a typical view

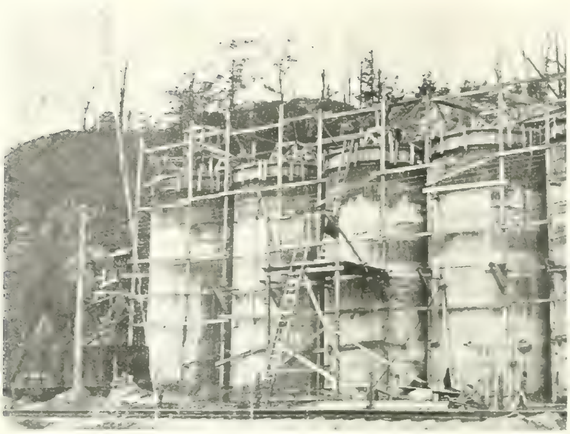


Fig. [illegible] The Concrete Bins Under Construction

of the bins under construction. They were covered with a wooden roof upon which was placed a fireproof composition roofing. It will be seen in the photograph after the fire that this roof was stripped clean. Had we built our bins of wood they would have been totally lost, and our supply would have been lost, crippling us for six months. We are very glad we built them of concrete. Now we have plenty of stock and are safe until spring, when we hope to have a new fireproof plant finished.

Gerson Isenberg
Crown Point, N. Y.

* * *

Unit Concrete in the Phillipines*

As to the use of concrete in unit forms such as block, architectural stone, posts, miscellaneous uses, these uses of concrete are increasing throughout the Philippine Islands, though its use has not as yet assumed such proportions as in the States or in Europe.

Some years ago a few buildings in various parts of the islands were built of concrete block. So far as I know, none of them was built by the government, and in most cases they represented the efforts of men unfamiliar with engineering principles. These buildings have not proven satisfactory, due to the fact that the islands are subject to frequent and sometimes severe earthquake shocks, and in general engineers feel that, owing to the frequency of these earthquake shocks, block construction is inadvisable in this country.

Architectural stone is not often used. The large number of permanent buildings which are constructed ought to provide something of a market for good architectural block, but to date the practice has been to mold in place architectural features which could more readily be cast and placed in unit form. As a result of this practice, the production of architectural stone has not been extensively developed in the Philippines.

Posts and Poles

The use of concrete for the construction of posts is rapidly increasing. The reason for this is that the cheaper timbers last a very short time in the ground and posts of better timber cost as much as concrete but do not look so well or last so long. Because of this the government is constructing large numbers of concrete posts for use in various parts of the islands. Both the Telephone Co. and the Manila Street Railway Co. are using large numbers of concrete poles; in fact, I believe they are setting no other kind of poles at the present time.

Under miscellaneous uses may be mentioned the manufacture of concrete roofing tiles. These have almost entirely replaced the porous clay tile formerly manufactured and used under the Spanish administrations in this country. The concrete tile has, from the standpoint of American engineers, proven much more satisfactory than the porous clay tile. Concrete floor tile is also used considerably.

Concrete Pipe

Under the head of unit construction concrete pipe should be included. This has a considerable use in the construction of small culverts, particularly culverts built in connection with the highways of this country. I believe, however, that concrete pipe has not been generally used for sewer work.

Probably that unit construction involving the largest outlay at present is the concrete pile bridge work. A large proportion of some parts of the Philippines is very low and flat. In many cases the foundations in these regions are poor. The government has found it very profitable to design concrete bridges erected on reinforced concrete piles for streams and more particularly for esteros in this low country.

J. L. Harrison
Dist. Engr., Bulacan District,
Malolos, P. I.

Concrete Monuments in Survey Work

Surveyors of the Bureau of Lands use in the neighborhood of 75,000 concrete monuments annually. The number used in one locality ranges from 5,000 to 25,000.

These monuments are used as permanent marks for corners of agricultural and city property. They are usually between 30" and 36" in length and from 4" to 7" in diameter, or of smaller dimensions.

I might add that native, unskilled labor ranges from 20 cts. to 50 cts. per day. Reliable, native, skilled labor for use in handling complicated plants is hard to get.

I am at present using about 100 monuments, 70 cm. long and 13½ cm. in diameter, daily.

J. L. Myers
Chief of Survey Party No. 13,
Corcar, Cebu, P. I.

* * *

Selling Concrete Products*

As to our method of pushing the sale of our goods. We receive daily reports as to work that is coming on. We circularize the architect and the owner. At present we are sending out two letters, as below, with the matter entitled "Hard Facts" printed in red on the left of the typewritten portion of the let-

Hard Facts

"ROMAN STONE"
IS GOOD STONE

"ROMAN STONE" IS MADE OF CRUSHED WHITE MARBLE AND SELECTED CEMENT, AND IS FINISHED BY MACHINE TOOLING.

"ROMAN STONE" IS UNIFORM IN COLOR, AND HARDENS WITH AGE.

"ROMAN STONE" IS HOMOGENEOUS, BEING CAST IN SAND-MOLDS. THE PROCESS IS PROTECTED BY PATENT.

"ROMAN STONE" CAN BE CUT OR CARVED LIKE NATURAL STONE.

"ROMAN STONE" IS REINFORCED.

"ROMAN STONE" LOOKS AND LASTS AS WELL AS NATURAL DRESSED STONE, BUT COSTS LESS MONEY.

When consulting your architect about the best material for the above building please consider the merits of Roman Stone.

If your architect will take advantage of our process of casting stone, we can save you much money, and produce a beautiful building at a moderate cost.

Permit us to give you a price—by sending us the plans and specifications. We will return them promptly, with a close price on all dressed stone

The best results are obtained when we SET the stone, as we have men experienced in handling and setting our stone, who take an interest in the work.

Yours truly,
The Roman Stone Co., Limited.

Second Letter[1]

When you are preparing plans for the above building please consider the merits of Roman Stone.

If you will take full advantage of our process of casting the stones in sand molds, the possibilities of greatly reducing the cost of the building while increasing the richness of design are obvious—it is the first stone made from a pattern that costs; you gain by repetition.

---

*These letters are in response to editorial inquiry

[1] "Hard Facts" is also a part of this letter—Editors

[illegible]

We have improved the process of manufacture, and increased our plant and equipment, so that we are now fully prepared to handle any contract, however large, to your satisfaction.

Yours truly,
THE ROMAN STONE Co., Limited.

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ter. We have travelers out who call regularly on the architects within a radius of 250 miles and keep in touch with the work in their offices, having artificial stone specified if possible or at least getting the privilege of tendering against natural stone. After the general contract is let we, of course, solicit the contractor and get after the owner if the size of the job warrants it.

We advertise persistently in the building trade journals and in some of the illustrated weeklies. We have large enamel signs which we place on the buildings where our stone is being used and best of all, we try to satisfy the architects and the owners so that they will be anxious to use our material in the next building where it can be used.

We prepare each year a list of our more important contracts and use it along with the circular letter to the owner and send it out when first published with a special letter to the architects. We consider this one of our best pieces of advertising.

GEORGE F. RIDDELL
Manager, Roman Stone Co., Ltd.
Toronto, Ont.

Reaching the Architects

We have always made it a practice to keep in the good graces of our architects and to call at their offices very frequently to learn what work they have under way and whether or not there will be use for our product. If so we endeavor to have our material specified—or material equally as good. We then get in touch with the owners of the buildings to be erected and bring them and their architects to our plant to inspect our material. This usually results favorably.

Advertising

Practically the only advertising that we do is when we enter the Rochester Industrial Exposition which is held every September. We endeavor to get out as good an exhibit as we possibly can, spending from $600 to $800 on it. We had a Demonstration Day at our plant last fall which was a big success as we entertained all the architects and a majority of the contractors of this city. This brought to us many new accounts as a good many of the contractors had never visited our plant. Outside of these two methods, the only other advertising we do is to talk "Norristone" to prospective buyers and we feel that the best advertising one can do is to supply a first-class product and give perfect satisfaction on all work turned out, thus making each job an advertising medium.

We do not send out any literature although we have been thinking of getting out a catalogue of our product, but do not know whether or not this would be money well spent.

Of course our business is now well established and our products known throughout the city and the only thing that we aim to do now is to keep the quality good, make prompt deliveries and give general satisfaction.

J. F. NORRIS
Rochester, N. Y.

* * *

Field Kinks on Anchors in Concrete Work

[*Editorial Note.*—This letter was written in reply to our request for more detailed information on methods of anchoring stair railings in the construction of the barracks at Fort Mills, Corregidor I., P. I., described in the Oct., 1913, issue.]

In reference to the sleeve and nipple anchors for fastening railing pipe standards, the proper application of this method of casting permanent anchors in concrete consists in using a sleeve or coupling for the size of pipe standard contemplated and threading into it a short piece about 8″ long, of pipe of the same size and battering or splitting the other end, as indicated at *A*, Fig. 1. Place the sleeve and short piece threaded to it in the form, holding it in place by wires with the sleeve projecting about 1″ from the finish surface of the concrete, being careful to plumb it. The standard screws into this and it must be plumb.

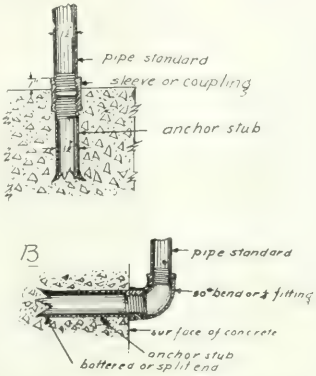


FIG. 1—SKETCHES SHOWING DETAILS OF SETTING PIPE ANCHORS

A shows the anchor set for a vertical standard. *B* shows the pipe anchor for a 90 deg. bend

When the pipe railing standards are desired on the side of the stair stringers or on the outward edge of a balcony, a 90-deg. bend fitting commonly called a "quarter-bend" is screwed to the short piece of 8″ pipe set into the form, in a similar manner, with the 90-deg. bend clear of the concrete so it can be turned to any angle desired for the pipe standard. This is shown at *B*, in Fig. 1.

Anchoring Stone and Terra Cotta

A method, used by the writer, for anchoring terra cotta and stone veneer to concrete is worthy of notice. For an example, if we wish to provide anchors for a belt course of terra cotta around the walls of a building, we place a ½-in. or ⅜-in. rod horizontally about 2½ in. above the terra cotta around the entire building where the belt course is to be placed, setting the rod in the form so that it will be almost flush with the surface and place wire anchors of No. 9 wire around the rod into the concrete at intervals of about 12 in. To anchor a block of terra cotta the mason simply cuts or gouges a hole around the rod, as shown in Fig. 2, and fastens the terra cotta anchor to it.

The benefits derived from using this method are, first, that the superintendent does not have to worry and take pains to set a number of separate anchors, taking chances in not having the anchors just right to meet the anchor holes in the terra cotta; second, this method saves considerable labor.

Another "kink" used by the writer is in setting bolts after concrete is in place. Instead of drilling a cylindrical hole, the hole is drilled so as to make it slightly larger inside, forming a dovetail. The bolt is then set with slight upset on its end and grouted in. This is shown in Fig. 3.

R. McC. BEANFIELD
San Francisco

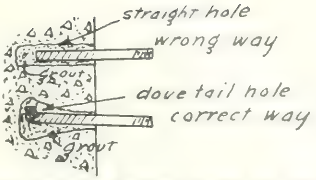


FIG. 3—SKETCH SHOWING INCORRECT AND CORRECT METHOD FOR ANCHORING BOLTS IN OLD CONCRETE

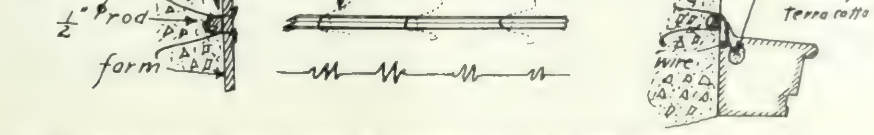
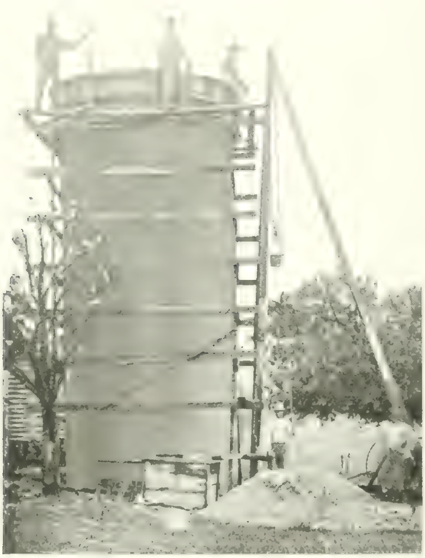

6d nail to hold rod to form
No 9 wire
½″ rod
form
No 9 wire anchors at 12″ c-c
hole in web of terra cotta
wire

FIG. 2—SKETCH SHOWING METHOD OF ANCHORING TERRA COTTA OR STONE VENEER TO CONCRETE

Notes on Silo Construction

I have built two concrete silos 10′ in diameter, 25′ high, with a 6-in. wall. The concrete was mixed 1:2:4, using sand and gravel. The silos were built two years ago and they have both been a success, so far, at least. I reinforced these silos with ⅜-in. rods vertically, and No. 9 wire horizontally.

I put in 2-ft. x 6-ft. frame doors, but in future work I would change the door frame, or in other words, would cut them out entirely and make a temporary frame to set in the wall and take it out when the concrete is set. The door would be made to fit snugly up against the wall. Wooden frames, left in place, will in time decay and make the silo almost useless.



General View of Silo Construction at Dove, Mo.

Five jack screws are shown at the base of the silo, also the general arrangement of the centering with the 3-leg derrick at the right.

I also embedded ½-in. x 12-in. bolts in the top of wall and left them sticking up 2½″ to attach the rafter. I am interested in silos for I have been engaged to build several silos next summer and would like more information on the question.

The concrete was hoisted up with a block and tackle and a three-leg tripod derrick, as shown in the accompanying illustration. A pail of concrete is shown going up. The outside forms were raised with 4 jack screws and for the inside forms we used wire cable carried across to the derrick. At the base of the silo in the illustration 5 jack screws can be seen.

D. D. Frederick

Dove, Mo.

A Court Decision on a Concrete Dam Patent

In the U. S. District Court, Southern District of N. Y., the following decision has been rendered by Justice D. J. Holt in the case of the Ambursen Hydraulic Const. Co., Boston, against the Hydraulic Properties Co., N. Y. C.:

This is a suit to enjoin the alleged infringement of a re-issued patent, Number 12,246, granted July 26, 1904, to Nils Frederick Ambursen, for certain improvements in dams. Claims 2 and 3 of the patent are relied on. They are as follows:

> "2. A dam comprising a base, an inclined concrete flooring overhanging the base, a plurality of spaced buttresses interposed between the base and flooring, and metallic reinforcing members embedded in the flooring and extending lengthwise thereof and across the buttresses."
>
> "3. A dam comprising a base, spaced buttresses rising therefrom, and a relatively thin inclined concrete flooring supported by and overhanging the buttresses and base, said flooring having metallic reinforcing members extending lengthwise of the flooring and across the buttresses."

There is nothing novel in either of these claims except the use of concrete in the construction of the flooring. Before the use of concrete, dams were made of timber, iron or steel, or of solid masonry. The complainant's concrete dam is substantially a reproduction in concrete of an old and familiar style of timber dam. The flooring is supported by buttresses with spaces between.

The solid masonry dam had become, before the introduction of the concrete dam, the standard form of dam for the retention of large reservoirs of water. The complainant's concrete dam is claimed to have, and I am satisfied from the evidence that it has, various points of superiority over the solid masonry dam. The cost is low. The material is plastic. It forms a solid mass without joints. But that is a feature of all concrete construction.

The great development of the use of concrete in recent years has made it a valuable building material for many purposes. Its use alone, or reinforced by iron or steel rods or wires, was well known in other forms of construction when the first concrete dam was built. It was natural that it should have been tried late in dam building because of the great danger arising from any insecurity in a dam; but it seems to me that it was certain, in the development of the use of concrete, to be ultimately used in dam building.

The description and drawing in the original and re-issued patent shows a dam with a curved flooring, and great stress is laid, in the descriptions and claims, on the importance of the curved flooring as causing the lines of pressure, perpendicular to the face of the flooring, to lie wholly within the limits of the base of the buttresses. No such dam has been built. All that have been built have a straight flooring. It is claimed that the patent applies to dams with a straight flooring, and, if it were valid in other respects, I think it would apply to them. The patent also describes and claims a method of fastening the buttresses to the base. But no claim is made in this case that the defendant threatens infringement of the curved flooring or of the method of fastening the buttresses described and claimed in the patent. The claim is that under this patent the complainant has a monopoly of dams made of concrete after an old style of wooden dams.

The general rule is, of course, that the substitution of one material for another is not invention. Undoubtedly the complainant's form of concrete dam has many advantages, but they seem to me to result simply from the natural qualities of concrete, and not from any newly discovered qualities. The use of concrete for dams has the usual advantages that it has for houses and bridges, and for many other forms of construction. But that does not make its first adoption for a particular use patentable. If this patent is valid the first maker of a concrete house or bridge or sidewalk was entitled to a patent for the thing made.

The bill is dismissed, with costs.

The Ambursen Co. have taken an appeal from this decision to a higher court.

Metric Conversion Table

The following table is taken from a recent hand book published by the L. S. Starrett Co., Athol, Mass.:

Millimeters	×	.03937	=Inches
"	=	25.400	× "
Meters	×	3.2809	=Feet
"	=	.3048	× "
Kilometers	×	.621377	=Miles
"	=	1.6093	× "
Sq. centimeters	×	.15500	=Square inches
" "	=	6.4515	× " "
Square meters	×	10.76410	=Square feet
" "	=	.09290	× " "
Sq. kilometers	×	247.1098	=Acres
" "	=	.00405	× "
Hectares	×	2.471	= "
"	=	.4047	× "
Cu. centimeters	×	.061025	=Cubic inches
" "	=	16.3866	× " "
Cubic meters	×	35.3156	=Cubic feet
" "	=	.02832	× " "
" "	×	1.308	=Cubic yards
" "	=	.765	× " "
Liters	×	61.023	=Cubic inches
"	=	.01639	× " "
"	×	.26418	=U. S. gallons
"	=	3.7854	× " "
Grams	×	15.4324	=Grains
"	=	.0648	× "
"	×	.03527	=Ozs., av'dupois
"	=	28.3495	× " "
Kilograms	×	2.2046	=Pounds
"	=	.4536	× "
Kilog's per	×	14.2231	=Lbs. per sq. in.
sq. cm.	=	.0703	× " "
Kilogram per	×	.06243	=Lbs. per cu. ft.
cu. m.	=	16.01890	× " "
Metric tons	×	1.1023	=Tons, 2,000 lbs.
(1,000 kilog's)	=	.9072	× " "
Kilowatts	×	1.3405	=Horse-power
"	=	.746	× "
Calories	×	3.9683	=B. T. units
"	=	.2520	× "
Francs	×	.193	=Dollars
"	=	5.18	× "

Notes on the Efficiency of Thin Solid Partitions

BY H. B. McMASTER*

THESE NOTES, FROM INFORMATION hitherto unpublished, based on tests preliminary to a fire test on partitions reported in CONCRETE-CEMENT AGE *for Aug., 1912, and the fire test proper, emphasize the relative value of solid partitions built with metal lath and cement mortar. Such a construction has shown up very well under fire test. It is, in fact, a reinforced concrete partition.*

It is not pleasant to be told that one is inferior to another and when we hear that the six principal countries of Europe with inferior fire-fighting methods and apparatus have a per capita fire loss of 33c while the United States, where perfection has nearly been attained in fire-extinguishing practice, has a loss of $2.50 per capita, we seem to be placed in a most unfavorable light. Whichever way we turn, we get no consolation; we are told among other things that of every thousand dollars worth of buildings we erect each year, we destroy ½ of that value by fire. We know it is not an abundance of water nor efficient methods of applying it which account for the startling comparison cited, but we do know that construction abroad is influenced more by a greater appreciation of the value of the ounce of prevention than is evidenced in America. Further, the municipal governments abroad are unrelenting in seeking out the person responsible for a fire and when he is found, they are not gentle in their assessments and fines. Among other things he must bear, is the expense of extinguishing the fire, also the damage suffered by all innocent persons, and he may have to pay a fine, also, as a sort of punitive measure.

We may reach this standard some time; in fact, we are growing daily in wisdom as lessons are driven home. Can we not hope to attain in time to that degree of wisdom shown in the criminal code of the "Imansk Republic," a settlement recently discovered in a remote part of Russia where the people had set up a government of their own? For about 20 offenses death is inflicted. Among these is not counted murder. Quoting from their code: "Whoever lets his house catch fire is hanged. If his wife only is guilty she is hanged; and he is beaten with sticks."

It is needless to say that this very extreme measure is referred to only as an example of how a people without modern methods of fire alarms and fire-fighting, has resorted through a governmental function to a measure that seems sufficiently drastic to protect lives and property in the community.

Nowhere has the growing appreciation of the wisdom of building to prevent fire rather than to depend on costly and complicated fire-fighting been shown more than in the city of Cleveland. Over two years ago V. D. Allen, City Insp. of Bldgs., in connection with his study of the physical properties of building materials, directed a series of tests to show simultaneously the effect of fire and water on a number of partitions. A complete report of these tests appeared in the Aug., 1912, issue of CONCRETE-CEMENT AGE.

Preliminary Tests

Before the official tests were undertaken some preliminary work was done —particularly with the view of determining the relative fire-resisting values of various mixtures. The process was one of elimination. Specimens would be constructed with a certain mixture of plaster on one side of a vertical line drawn through the center and a different mixture on the other half. How this worked out is shown by some plates taken of specimens so tested Feb. 10, 1912.

Fig. 1 is a view of the fire-side of a portion of metal lath on wood studding which had been tested according to the specifications of the Am. Soc. for Test. Mat. The right side is plastered with a standard brand of gypsum plaster, the left half with a mixture of 1 part Portland Cement, ⅛

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*Commissioner, Assoc. Metal Lath Mnfrs., Youngstown, O.

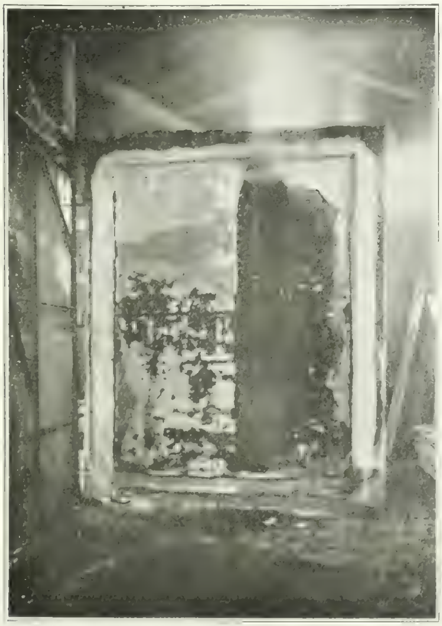


FIG. 1—A PARTITION OF METAL LATH ON WOOD STUDDING, AFTER THE FIRE AND WATER TEST

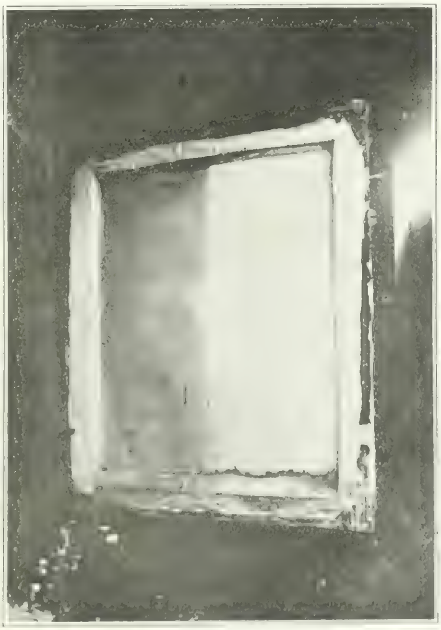


FIG. 2—THE FIRE SIDE OF [illegible] PARTITION BEFORE THE FIRE [illegible]

[illegible]

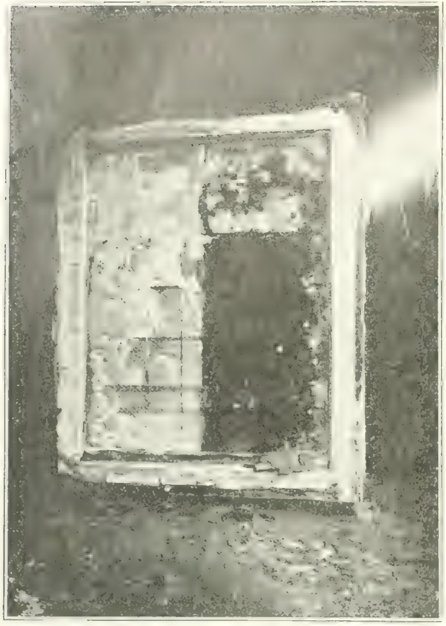


Fig. 3—Fire Side of a Partition After the Water Was Applied

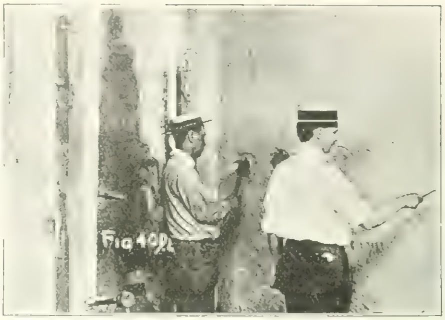


Fig. 4—[illegible] the Solid Partition After the Fire

part hydrated lime and 2½ parts sand. Fig. 2 is the fire-side of a 2-in. solid metal lath wall with patent plaster on the right side (as viewed) and the above cement mixture on the other half. This plate was taken before the water struck it and a characteristic is shown here that was noticed in all of the experiments; that very shortly after the heat was applied, large blisters would start out from the surface of the patent plaster side and very shortly the shell formed by these blisters would drop off. The extent of the recalcination is shown very clearly in the next illustration, Fig. 3, which is the same specimen after the water had been thrown on.

The Best Cement Plaster

These experiments on plaster developed the fact that a 1:0.1:2.5 mixture, using Portland cement, hydrated lime and clean sharp sand, is the best fire-retarding mixture consistent with good building practice. In the official tests which followed (June, 1912), this mixture was the one used on all of the metal lath specimens except the stucco wall as was explained in the official report at the time.

The 1912 Tests on Partitions

The tests referred to were somewhat more severe than would obtain in an ordinary fire, but the observations made by the committee in its report indicated how early in the test the failure of the wood lath partition became imminent and how remarkably the metal lath construction stood up even though on wood studding. Other types of walls were tested, the stucco wall of metal lath and cement plaster on frame to determine how far walls of this kind might retard the spread of fire and the 4-in. hollow wall built of 2½-in. steel studding with metal lath and cement plaster which lived up to its reputation as a most efficient light partition wall. Plaster board on wood studding was also tested, which showed signs of failure perhaps earlier than did the wood lath.

In this discussion the author wishes particularly to emphasize the findings on the No. 3 panel in the test referred to above. This partition was 2" over all, using 24-ga. metal lath on ¾-in. steel channel studding with plaster mixed 1:0.1:2.5, using cement, lime and sand.

In this panel, when tested, the temperature reached a maximum of 1,929° F. in the 2-hr. fire test. From Fig. 4 it is quite obvious that neither fire, smoke nor water went through the wall. The hole in the central part of the illustration was made by 5 hard blows with the hammer side of a broad hatchet; a similar hole was being made with an ordinary hammer at the left. These experiments seemed to indicate that this wall might be depended on to resist lateral blows after two hours' fire and the application of water.

A feature interesting to the fireproofing expert is the ability of this type of wall to weave, buckle, become distorted—get all out of shape—and still retain its integrity; that is, protect adjoining premises.

Space Economies With Thin Walls

With the acceptance of this light wall as a good fire-retardant for non-bearing partitions, we want to consider other features. It is apparent that the dead load in a building is much reduced by using these 2-in. walls and what should appeal most to the building owner is its space-saving value. This is portrayed by the diagram (Fig. 4) giving comparative space consumption of the 2-in. and the 6-in. wall.

Estimated Costs of Solid Partitions

Recent estimates of the cost of such a 2-in. partition in Cleveland are as follows:

Studding and lath erected	$ .54 per sq. yd.
Plastering	.95 per sq. yd.
	$1.49 per sq. yd.

On large jobs these figures can be reduced to,

Studding and lath erected	$ .45 per sq. yd.
Plastering	.85 per sq. yd.
	$1.30 per sq. yd.

Experienced plasterers state that there is no increase in the cost from using

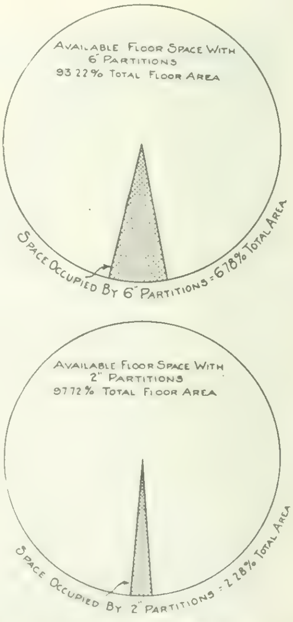


Fig. 5—Diagram Showing Comparison of Available Floor Space in Two Buildings, One With 2-in Partitions, Other With 6-in Partitions, Total Floor Area [illegible] Sq. Ft.

Portland cement plaster where there are large surfaces to cover. The cement plaster requiring more time to set than the quick-setting plasters, the plasterers need the larger surfaces to cover before they double back on the "set" work.

At times and in some localities these partitions are built at a cost of less than $1.00 per sq. yd.; from that, the cost will range to a point above the highest figure given above according to labor conditions and the price of materials.

Partition Values

The concluding thought after considering the above facts is that, it becoming necessary to decide what kind of partition to install to secure convenient subdivisions of floors, the following requirements must have weight:

1st Fire-resisting arrangement
2nd Fire-resisting qualities, or ability to resist fire and the erosive effects of water
3rd Ability to resist the impact of hose streams or falling debris
4th Ability to give way under high temperatures sufficiently and without hazard to the stability of the wall, to take up the expansion and contraction
5th Construction that will retard the transmission of sound.

The primary function of the partition is to subdivide large areas into spaces suitable to the occupants' requirements, but with modern construction influenced by a wider appreciation of the need for ample protection of the lives and property of the people to be housed, we must take it as most important to *localize* an incipient fire.

These notes on the 2-in. solid partition are in the main to give out a much broader knowledge of this light, low-cost, space-saving, fire-resisting and easily-movable construction which fills many of the important functions of dividing walls to form offices, rooms or corridors, or to enclose stairs, elevators or other openings or subdivisions.

Curb Block for Use Along Street Railway Tracks

Since street railways were first built quickly worn stone curb blocks have been in evidence, and latterly the more readily fractured clay brick blocks. Doubtless many have endeavored to think out a curb block which will have a more permanent surface; as those used at present adjacent to the track show early signs of wear, and often become sunken to such an extent as to require attention in a short time after having been laid. On tracks in the main streets of cities the surfaces of the stone blocks adjacent to the rails have to stand even more wear and tear than the rail itself. The idea of a recent invention along this line is that street railroad practice demands that the curb adjacent to the rail should bear in the nature of a continuous girder from tie to tie and that its surface should have wearing qualities as good as the adjoining rail.

Ordinary concrete curbs have hitherto been considered impracticable because of cracking due to vibration, however, the United Railroads of San Francisco have experimented with the patent reinforced concrete metal-grilled-top curb here illustrated and after months of service under heavy freight traffic have found it satisfactory, while the stone curbing laid at the same time had begun to wear and settle unevenly.

This curb is slightly more expensive than the stone paving but as an offset to this a saving is made in being able to use advantageously the T rail in place of the comparatively heavier and more expensive "Trilby Rail."

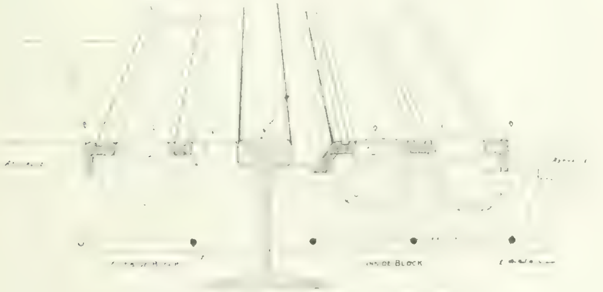


FIG. 1—REINFORCED CONCRETE CURB BLOCK IN SAN FRANCISCO

B-B, cast iron tops; C C & D D, frogs alternate at 10" centers; F, bosses, frogs cast into them

The length suggested for each of these curb block is 10' and the method of making the block is to place the cast iron grille face down in a mold and fill in with concrete of desired proportions.

The concrete shown on the top of the finished curb forms a roughened surface to prevent slipping, but is not amenable to wear, as the spacing of the metal does not permit of wheel tires wholly traveling on it.

From an aesthetic point of view the appearance of tracks laid with this curb is much superior to those laid with stone paving. This is noticeably so in wet weather, when inequalities are shown up by water lying on the streets. Taggart Aston, consulting engineer, Foxcroft Building, San Francisco, is the inventor.

Along this same line CONCRETE-CEMENT AGE has a contribution from Oreste Coari, Municipal Surveyor for Street Work, Rome, Italy, which explains a similar device developed abroad. It follows:

Fixing tram rails along streets which are subjected to much traffic or to ordinary vehicles in the most central parts of towns, has rendered a good paving very difficult and expensive, because an unevenness soon develops between the rail and the floor of the street, a condition particularly inconvenient when the roadway is narrow and the traffic intense.

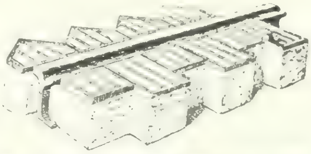


FIG. 2—PAVEMENT BLOCK USED ALONG TRACKS IN ROME

While the channeling of the rail is not noticed by vehicles in motion because the width of the wheels is always greater than that of the channel, the difference of the level, though small, between the rail and the street paving, always causes a sinking which hinders the wheels of the vehicles.

The writer, after a carfeul study, has invented a new kind of block made of concrete or cement or asphalt, with metallic grating on their surface. These blocks are fixed against the rail and shaped so as to be in contact with lateral spaces of the rail as shown in the accompanying sketch. When placed, these special blocks have the advantage of resting on the foot of the rail and adhere to it, so as to render impossible any jutting out or difference of level between the rail and the surface of the blocks, forming a perfect level, as shown in the sketch. The metallic head protecting the plocks renders their surface very resistant ot wear. It is useless to say that these blocks can be made of all shapes and dimensions, suiting perfectly the various styles of rails and different systems of paving. The sketch shows the shape and system of blocks for pavements adopted in Rome.

This system is protected by industrial patent certificates, and is adopted in Rome since 1898.

The results obtained may be considered very satisfactory, as the system meters (miles 125) or 50 kilometers of extends for over two hundred kilo- complete track.

NEW BOOKS

General Specifications for Concrete Bridges. Wilbur J. Watson, Cleveland, O. 11" x 8¼", paper bound, 66 pp., illust., price $1.00.

These specifications are intended as a general working basis for concrete bridge construction, and have met an actual need of the profession. Such specifications should be found especially useful where they are made the basis of competitive design. In such cases it would be possible to compare all design on an equal basis.

Designers' Charts for Reinforced Concrete. By H. B. Andrews, Boston, Mass. 12" x 9", paper bound, 24 sheets, illust.

These charts, which were first published in 1909, have been in quite successful use for a good many years and should be found of value to engineers handling design problems. Considerable space could have been saved if the text matter had been printed on both sides of the sheet. As it stands now the book is bulkier than required.

Panama in Pictures. By Thomas H. Russell,. Published by M. A. Donohue & Co., Chicago. 8¼" x 5¼", paper bound, 64 pp., illus.

This is a brief but well written presentation of the construction of the Panama Canal. The text is very concise, outlines the past developments, discusses the historical situation and presents some interesting information on the construction features of the work. The booklet is profusely illustrated.

The Gypsum Industry in 1912. By Ralph W. Stone. Published by U. S. Geological Survey, Government Printing Office, Washington, D. C. 15 pp., 7½" x 10", paper cover.

This is a comprehensive report covering in detail the distribution and character of gypsum and gypsum products. The matter is brought right up to date and the report should be of value to anyone interested in this subject.

Reinforced Concrete for Houses. By Benjamin A. Howes. Published by the Assn. of Amer. Portland Cement Mfrs., Philadelphia. 9" x 6", paper bound, 24 pp., illus.

This is a reprint of that famous paper delivered by Mr. Howes a good many years ago which sounded a key-note in the development of modern residence design. To those not familiar with this paper when it was first published, this pamphlet will be of much interest.

Small Concrete Bridges and Culverts—Universal Portland Cement Co., Chicago, 9" x 6", paper bound, 72 pp., illus.

The foreword of this book states that the floods of the spring of 1913 have had remarkable effect in crystallizing public sentiment in favor of concrete bridges and hundreds of bridge structures of steel and timber which were swept out in the flood will be rebuilt in concrete. This booklet covers in a detailed and interesting way the essentials in bridge construction and will be found of value to all builders and engineers having to deal with these problems.

Builders' Quantities—By Wm. Edgar Ballard. Published by Longmans, Green & Co., New York, London, Bombay and Calcutta. 7½"x5", cloth bound, 124 pp., illus.

This volume is an elementary text on estimating and while it was prepared to meet in particular the requirements of English practice and all the treatment is to that end, yet there are a good many points covered in an interesting way which should be of general information. The volume is neatly bound in limp cloth and printed on a heavy paper. There are no halftones.

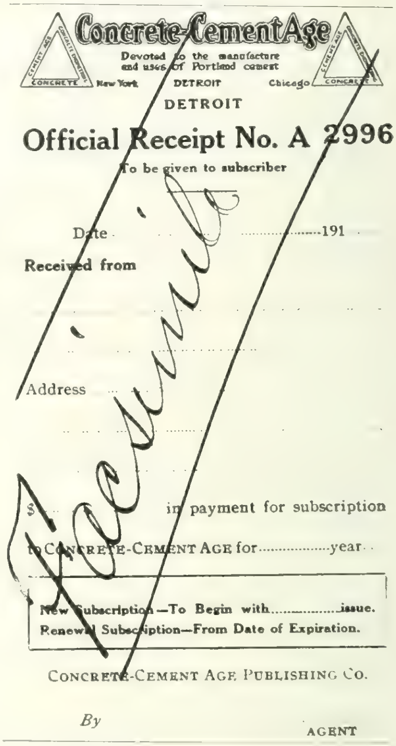
Concrete in the Barnyard—Universal Portland Cement Co., Chicago, 9" x 6", paper bound, 32 pp., illus.

This pamphlet is a specific text, covering in detail the many uses of concrete in and around the farm. Every possible construction is covered very carefully with detailed photographs, sketches and plain text.

Modern Homes of California. Los Angeles Investment Co., Los Angeles, Cal., 10½" x 7¼", paper bound, 96 pp., illus., price 50c. This is a plan book of small dwellings, mostly of frame construction.

Do Not Be Fooled by Unauthorized Subscription Agents

It is very unfortunate that the work of reputable and responsible subscription agents of CONCRETE-CEMENT AGE should, in a measure, be handicapped by the suspicions which are occasioned through the operation of unreliable agents. Accompanying this notice we publish a facsimile, full size, of the official receipt blank used by CONCRETE-CEMENT AGE subscription representatives. These receipts, of course, are not all numbered like the one shown, but they are numbered serially through a book of either 25 or 50 blanks. When an agent writes a receipt for a subscription payment a copy of that receipt is made on a blue sheet with which the white pages are inter-leaved. The careful and reliable agent invariably sends the blue copy immediately to this office as evidence of a subscription payment received. If you have any doubt whatever of an agent to whom you propose to make a subscription payment, ask him to show you a letter authorizing him to act for CONCRETE-CEMENT AGE. This letter will state the series of numbers in the particular receipt book which this agent is using.



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Devoted to the manufacture and uses of Portland cement

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By AGENT

We regret very much to have to advise that prospective subscribers should not make payments to Geo. Scott, whose address was Springfield, Ill., and who was equipped with a receipt book containing blanks numbered 2101 to 2150.

We also advise that subscription payments should not be made to a man who has, in at least one instance, signed a receipt for a subscription payment for CONCRETE-CEMENT AGE with the name C. F. Seaver. The last we heard of this man he was in St. Francisville, Ill., and in one instance gave a receipt for a subscription payment on an order book blank with yellow paper.

Insist upon an official receipt. This man Seaver accepted $1.00 for a year's subscription to CONCRETE-CEMENT AGE. The subscription price in the United States is $1.50.

We should like information as to the whereabouts of Seaver and Scott.

Concrete Organizations, Officials and Conventions

American Concrete Institute, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa. Convention, Chicago, Feb. 16-20, 1914.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Building, Washington, D. C.

American Road Builders' Association, Secretary, E. L. Powers, 150 Nassau St., N. Y. C. Convention and Exhibition, First Regiment Armory, Philadelphia, Dec. 9-12, 1913.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Building, Philadelphia, Pa.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; J. P. Beck, Sec. Seventh Chicago Cement Show, Coliseum, February 12-21, 1914.

Iowa Association of Cement Users, Henry H. Dean, Glenwood, Ia., Secretary.

National Conference on Concrete Road Building, J. P. Beck, 72 W. Adams St., Sec. First meeting Auditorium, Chicago, February 12-14, 1914.

Nebraska Cement Users' Association, Secy.-Treas., Frank Whipperman, Omaha, Neb. Convention Feb. 2-4 and Show Jan. 30 to Feb. 4, 1914, Omaha.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Bldg., Minneapolis, Minn.

The American Highway Association, at its recent convention in Detroit, re-elected officers and directors as follows: President, Logan Waller Page; Vice-President, W. W. Finley; Treasurer, Lee McClung; Secretary, J. E. Pennybacker, Jr.; Field Secretary, Chas. P. Light; Directors—L. W. Page, W. W. Finley, James S. Harlan, Alfred Noble, T. G. Norris, Chas. Whiting Baker, A. B. Fletcher, Roy Chapin, Jos. W. Jones and L. E. Johnson.

The Michigan State Good Roads Association, at a meeting in connection with the American Road Congress in Detroit recently, re-elected officers as follows: President, Philip T. Colgrove; Vice-President, N. P. Hull; Secretary, A. A. Anderson; Treasurer, J. Edward Roe.

The third annual meeting of the United States Good Roads Association was held in St. Louis at the old exposition grounds for six days, beginning November 10. Senator John H. Bankhead, of Alabama, is president of the association and, is taking a keen and active interest in the movement.

Coming Good Roads Congress

Plans for the Fourth American Good Roads Congress of American Road Builders' Assn. in the First Regiment Armory, Broad and Callowhill Sts., Philadelphia, are being worked out in detail by the Convention Committee and officials having the matter in charge. The following is an outline of the program.

Organization

1. Highway Officials—Their Duties and Powers; 2. Division of Expense, of Responsibility and of Authority between the various Municipal and Other Units participating in a Road or Street Improvement; 3. The Relation to Each Other of the Contractor, the Chief Engineer, the Resident Engineer and the Inspector; 4. Details of Arrangements for the Use of Convict Labor.

Construction

1. The Proper Determination of the Amount of Re-Alignment and of Grading to be done; 2. The Factors Governing a Proper Selection of a Road or Street Pavement or Surfacing; 3. Materials and Methods Suitable for Road Surfaces; 4. Unit Price vs. Lump Sum Contracts; 5. Plant Equipment; 6. Preliminary Traffic Census; 7. Efficiency and Economy of Using One Size Crusher Run Stone, Bituminous Concrete Pavements as a Substitute for Bituminous Pavements Constructed by Penetration Methods; 8. Dirt Roads.

Maintenance

1. Sub-Organization for Securing Efficient Maintenance; 2. General Methods of Repairs and Renewals; 3. Methods of Dust Prevention; 4. Maintenance of Different Road Surfaces.

The general plan of providing for discussion of subjects, rather than long papers, which has been so successful in the past, will be adopted at this meeting. In connection with the Congress and convention, there will, as usual, be held an exhibition of road machinery, materials and appliances. This exhibition will be known as the Fifth Annual Good Roads Exhibition, and will include machinery and equipment used in construction, repair and maintenance of roads and pavements. This exhibition will also be held in the First Regiment Armory.

Secretary Houston of the Dept. of Agriculture says that the state and federal governments should work together for highway improvement in order that a large proportion of the money annually spent for road construction may not be wasted. In his own department the Office of Public Roads has been demonstrating the value of proper road building by the construction of certain object-lesson roads, and the forest service is carrying out his idea of national and state co-operation in road building. The law requires that 10% of the gross receipts from the national forests shall be spent in the states in which the forests are situated. This money is expended for road improvement under direct control of the Secretary of Agriculture. The amount appropriated under this act, based on the receipts of the national forests for the fiscal year ending June 30, 1913, is $234,638.68. From the 1912 receipts for this 10% road item, there is an additional $134,831.10, which is still available.

Tariff Changes Affecting the Concrete Field

Many items in the new tariff schedule, effective beginning Oct. 3, 1913, are factors in cement and concrete development. The following list, revised from the complete schedule, gives the tariff changes in such items:

SCHEDULE A
CHEMICALS, OILS AND PAINTS

	Old rate	New rate
Calcined magnesia	7c lb.	3½c lb.
Carbonate of magnesia ..	3c lb.	1½c lb.
Barytes	76.9%*	15%
Barytes, manuf'd	64.24%*	20%
Ochre, crude	5.92%*	5%
Ochre, powdered	40.93%	5%
Venetian red	30%	10%
Zinc oxide, dry.........	15.60%	10%
Zinc chloride and zinc sulphate	1c lb.	½c lb.

SCHEDULE B
EARTHS, EARTHERNWARE AND GLASSWARE

	Old rate	New rate
Portland and hydraulic cement	21.32%*	Free
White non-staining Portland cement	20%	10%
Lime	5c 100 lbs.	5%
Plaster rock	25.42%*	10%
Keene's cement	39.73%*	10%
Other cement	20%	10%
Asphaltum and bitumen..	$1.50 ton	50c ton
Limestone rock asphalt...	50c ton	10%
Mica, unground, val. under 15c lb.............	34.62%*	4c lb.
Mica, unground, val. over 15c lb.	34.62%*	25%
Mica, ground	25%	15%
Surveying instruments...	45%	25%
Marble, dressed	$1 cu. ft.	75c cu. ft.
Marble, paving tiles.....	8c ft.	6c ft.
Mosaic cubes, loose.....	¼c lb.+20%	20%
Same attached to paper..	5c ft.+35%	35%

SCHEDULE C
METALS AND MANUFACTURES OF METALS

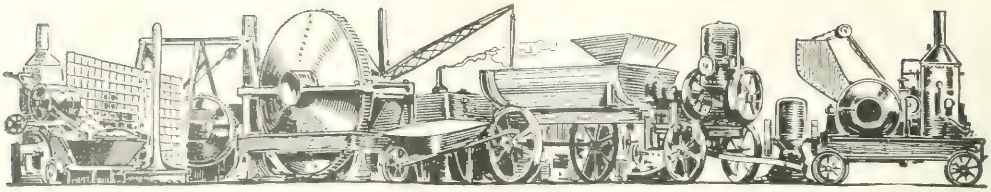
	Old rate	New rate
Bar iron	[illegible]	5%
Round iron rods.........	27.18%*	5%
Iron beams and other structural shapes of iron or steel	[illegible]	10%
Sheet iron or steel.......	27.49%*	12%
Steel ingots made by Bessemer or similar process..	21.98%*	Free
Steel bars and shapes made by Bessemer or similar process	[illegible]	5%
Round iron or steel wire..	38.03%*	15%

SCHEDULE N
SUNDRIES

	Old rate	New rate
Fulminates	30%	Free
Gunpowder and explosives—		
Value over 20c lb.	[illegible]	Free
Value under 20c lb....	2c lb.	Free

*For the purpose of simplifying comparison, certain of the old duties, compounded of "ad valorem" (according to value) and "specific" (according to quantity) rates, have been reduced to "ad valorem" equivalents.

The article on "Pit Silos" published on p. 206 of the November issue was prepared by Alvin T. Steinel, formerly editor of the "Southwest Trail," but now General Imigration Agt. of the Rock Island Lines, with headquarters at Chicago. This information was not available when the article was printed.



New Equipment, Methods and Materials

The forward progress of any industry is measured by the tools with which it works, and the engineer-manufacturers who are developing new and better methods and materials, merit recognition and co-operation. In this department are published brief descriptions of the new developments of the field

The Eberling Tile Machine.

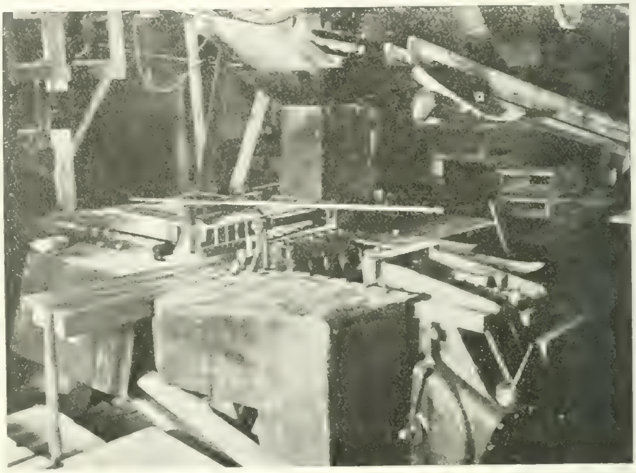


Fig. 1—Eberling Tile Machine in Moline Plant

With the invention of the Eberling cement construction tile machine, the concrete field has been considerably enlarged and a worthy opponent for clay tile put on the market. This machine made its first appearance something over a year ago in Cleveland, O., and the first plant has been recently installed for the Moline Cement Products Co., Moline, Ill. With this equipment the tiles are made by mechanical compression, using cams and eccentrics in a very heavy machine. The operation is about as automatic as it could be. At the feed end of the machine, an operator places an empty wooden pallet on the feed table. The pallets are a light bottom board the size in plan of the section of the tile made, with side pieces in two opposite sides the height of the tile, and are shown at the right in Fig. 1. A simple mechanism pushes the pallet under the feed hopper, where it is mechanically filled with the semi-dry mix and automatically struck off.

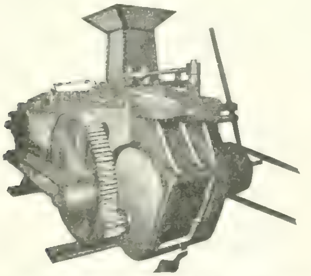


Fig. 2—[illegible] Structure of the Machine

The operation which pushes an empty pallet under the hoppers pushes the loaded pallet out into the compression chamber, where are the lid, knives and plungers, that automatically turn out the tile ready for the steam rooms. In operations which quickly follow one another, the sides, top and joint blades are forced through from one side. These lock into position and from the other side the pointed shuttle-like plungers which form the hollow cell of the tile enter the solid constrained rectangular prisms of concrete with a pressure of 15 tons. The plungers also lock; then a pressure of 45 tons on the ends of the tile is applied and the machine is through with the tile with the exception of drawing out the plungers and knives and shoving the formed tile out onto a bench. This last operation is done by a third pallet coming beneath the hopper. The plunger and knives and the heads giving the end pressure are worked by a heavy arm and gears properly timed, making the machine entirely automatic.

An entire operation, from the time the empty pallet is placed on the feed table until the same pallet is lifted off with the finished tile, is completed in one revolution of the big geared wheel which shows at the left of Fig. 2. At the Moline plant the machine is now turning out a tile every 12 seconds so that with 4 single units to the pallet gives a capacity of 1,200 per hr.

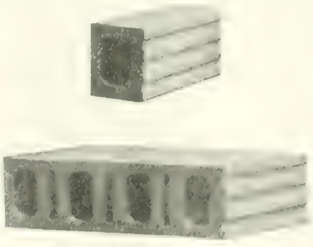
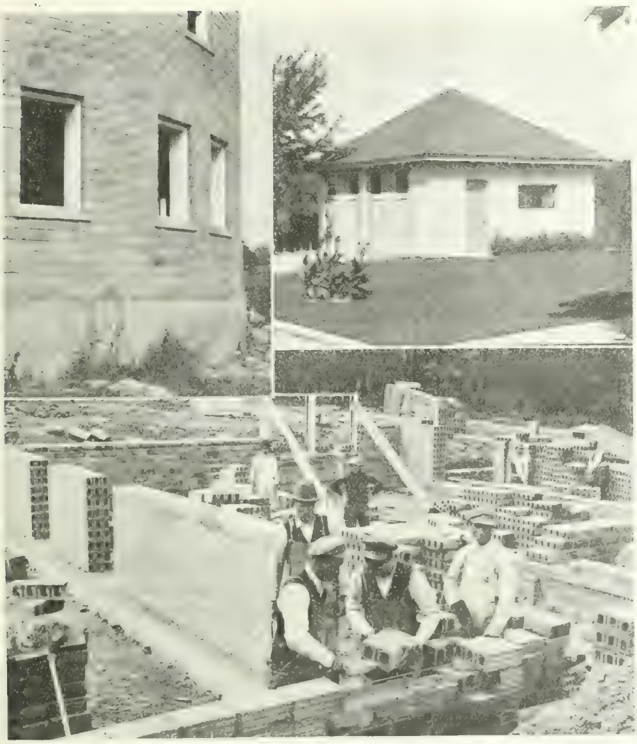


Fig. 3—[illegible]

The tile are taken from the machine to the "steam tunnel." Only a small head of steam is carried, and 48 hours in the steam are given.

The knives and plungers of the machine can be adjusted so as to make four sizes of tile; the smallest, 4" x 5" x 12", is taken as a unit. The other sizes are of two, three and four units. Tile of more than one unit can be separated into smaller sizes or into separate units. These dimensions allow a tile wall to conform with any wall of brick and while these tile are designed primarily for walls which are to have a covering of stucco or some other veneer, a neat outside wall can be made with them.

Tests were made for the Moline Cement Products Co. on tile from its machine, in the testing laboratory of John Deere Plow Co., Moline, Ill.



Figs. 4, 5 and 6—Building Tile in Use
In Fig. 4 in the Upper Left Corner is Shown a Detail View of the Wall of a Circular Barn at the Boys' Farm, Hudson, O.; Fig. 5 Shows a Garage of the Tile Covered with Stucco and Fig. 6 Shows Tile Being Laid in a Foundation Wall for a Large Residence in Cleveland

Four-in. tile were used, made of 1:4 concrete and the report of the test is as follows:

Accompanying illustrations show individual tile—one unit and a 4-unit tile, Fig. 3 and also the tile in use.

Compression Test of Concrete and Clay Building Tile for J. B. [illegible]. Size of Tile 4" x 5" x 12"

Tile were set on edge with the top and bottom surfaces embadded in plaster of Paris to get uniform distribution of the pressure.

No.	Material	Age	Thickness of webs	Length	Area sq. in.	Ultimate strength	Ultimate strength per sq. in.
1	Concrete	16 wks.	.70"-.76"	12.58"	18.37	33,140 lbs.	1,804 lbs.
2	Concrete	8 wks.	.85"-.83"	12.10"	20.31	28,349 lbs.	1,395 lbs.
3	Concrete	3 wks.	.77"-.82"	12.20"	20.01	27,140 lbs.	1,357 lbs.
4	Clay	.....	.48"-[illegible]"	12.30"	12.30	19,490 lbs.	1,583 lbs.

Porch Columns of Concrete

The illustration shows the residence of C. M. Menefee, 2430 Thomas street, Fort Wayne, Ind. The concrete work was done by the Menefee Art Stone Co. The porch columns, 20 in all, are of granite concrete. These and the 7 ornamental lighting standards were made in molds of the Architectural Mould Co.[1]

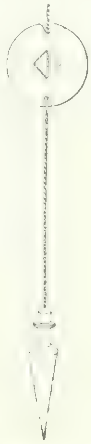
---

[1] Detroit

A Pocket Target for a Plumb Line

A plumb bob and line is under most circumstances the most practical and probably accurate method of transferring a point vertically and of determining whether a corner or column is plumb. In laying out a building or other similar work it is very often necessary to sight on to a plumb bob string from a builder's transit.

The accompanying illustration shows a little celluloid target which can be easily attached to a string and makes it possible to see the string more easily. Such a target, which is manufactured by Kolesch & Co., N. Y. C., should be extremely useful whenever a plumb bob string is used as a sight.

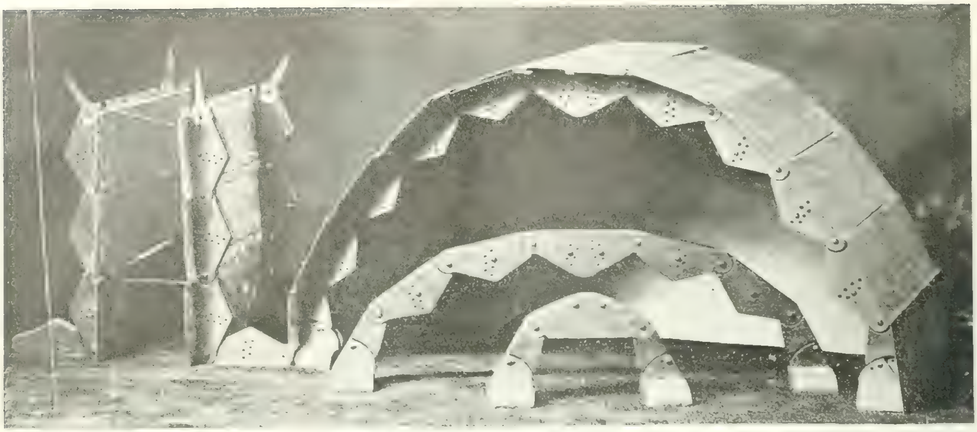


Detail Sketch Showing the Operation of a Target for Plumb Line

The Blaw Steel Construction Co., Pittsburgh, maker of concrete forms, has secured the services of L. W. Barnett, for many years secretary and sales manager of the Franklin Steel Co., Franklin, Pa. Mr. Barnett will be located at 165 Broadway, N. Y. C., and will represent the Pittsburgh concern in that city. He will handle the sales of transmission towers, steel poles and other products of the company. The Blaw company recently moved its offices to the new plant at Hoboken, a suburb of Pittsburgh. An office, however, is retained in the Farmers Bank building.

1914 Coltrins Have Larger Wheels

To increase the ease of portability and develop a somewhat higher discharge point for the concrete, the 1914 Coltrin "continuous-batch" mixer, manufactured by the Knickerbocker Co., Jackson, Mich., will have slightly larger wheels on front trucks, increasing from 18" to 22".



THIS SHOWS IN DETAIL THE OPERATION OF ESSENTIAL FEATURES OF THE FRICK STEEL ADJUSTABLE CENTERING

A detailed examination of the wall form set up at the left will show the manner in which the projecting finger holds the segmental centering in position

Adjustable Segmental Centering Units

The last few years has seen many interesting developments in forms for concrete work. A very ingenious development along this line is shown in the accompanying illustration in which the surface on which concrete can be molded is produced by a plate which is held in position by an adjustable rib at each end. The stud, instead of being a continuous unit, is built up as the work progresses by the two units to which each plate is attached. The unit plates can be fitted to any contour by an adjustable feature in the segmental stud which is about as follows: Each unit stud or brace is a double steel casting with a projecting finger as shown. The projecting finger fits into the adjacent ribbed unit and is fastened in place by a pin. Any curvature is thus made possible and the centering unit is adaptable to almost any kind of work. The adjustable steel centering is an invention of Henry H. Frick and is being made by the Frick Mfg. Co., Fricks, Pa.

Discharge Chutes for Continuous Mixers

The 1914 model of the Coltrin continuous mixer will be equipped with a discharge chute having a radius of 10'. The Knickerbocker Co., Jackson, Mich., manufacturer of this mixer, states that by the use of this chute, 12 men, including the foreman, are enabled to charge and operate the machine and also place the concrete, even when operating at the maximum capacity of 12 cu. yds. per hour. In other words, this equipment is rated to produce 1 cu. yd. per hr. per man, using all common labor except the foreman. The accompanying plate shows the operation of the chute. This is a steel chute suspended on a swivel and works very well.

THE COLTRIN PORTABLE MIXER WITH CHUTE IN OPERATION

New School House Construction

The United Fireproofing Co., 1133 Broadway, N. Y. C., has been awarded the contract for the construction of a $47,000 fireproof high school at Millbury, Conn. John T. Simpson, of Newark, N. J., is the architect and engineer.

Ribbed Mesh Patent Suit Decisions

A light expanded metal, made more rigid by ribs formed in the metal sheathing, is today a valuable and widely used structural material. The past few years have seen many materials of this type brought onto the market. There has been, consequently, some patent conflict, and the Corrugated Bar Co., Buffalo, makes the following statement in regard to a recent decision:

In the suit of the Trussed Concrete Steel Co. vs. the Corrugated Bar Co. for infringement of its "Hy-Rib" patents by the "Corr-Mesh" material of the latter company, Judge Hazel, in the U. S. Court for the Western Dist., N. Y., handed down a decision Sept. 8, in favor of the Corrugated Bar Co. The decision limits the "Hy-Rib" patent to the specific construction shown and described, and states that the 'claims barely escape anticipation by the references cited."

This case has aroused considerable interest in the building trade on account of the prominence of the two companies and the important position occupied by their respective materials.

In regard to this same suit, the Trussed Concrete Steel Co., Detroit, makes the following statement:

A rehearing of the above case has already been requested, because of alleged variance between the evidence and the decision; also because the same patents upon which the above case rested were the basis of a suit in the U. S. Court for the Northern Dist. of Ohio, where judgment was rendered in favor of the Trussed Concrete Steel Co. as against the original patentee, William D. Forsyth, and a full accounting ordered.

The Inland Steel Co. announces that it has opened a branch sales office at Milwaukee, C. M. Easterly in charge as district sales manager. This step is necessary to serve properly the important business developed in Milwaukee and adjacent territory.

Cost of Operating Salamanders

A warehouse recently completed near Chicago had about 72,500 cu. ft. of air in each of the five stories and in discussing the matter of concrete in cold weather a recent Bulletin of the Universal Portland Cement Co. presents some valuable cost data on the operation.

On one floor 12 salamanders were kept burning for 5 days, in which time an average of 18,000 lbs. of coke was burned per 24-hour day, or 150 lbs. per salamander per day. The inside temperature was maintained at about 60° F., while the outside temperature ranged between 10° F. and 55° F. The labor necessary was one-half the time of one man per day and one-half the time of a night watchman. The total cost of the salamanders was $16.80, making the cost per floor $3.36. The cost of heating this floor was:

Coke, 4½ tons at $6.75 per ton..	$30.38
Salamanders, cost per floor......	3.36
Labor, 20 hours, at 37½c per hr..	7.50
Labor, 30 hours, at 25c per hr..	7.50
Total	$48.74
Cost per salamander, per day....	.81

The same number of salamanders were used on two other floors, burning for five days on one floor and four days on the other. During these periods a temperature of about 60° F. was maintained within the building, while the outside temperature varied from 10° F. to 55° F. The cost per salamander per day for the two floors was $0.77 and $0.72 respectively.

Tonnage of Reinforcing Steel

According to statistics given out by the Am. Iron and Steel Inst., the production of iron and steel bars for reinforced concrete work in 1912 amounted to 274,332 tons, as compared with 258,741 tons in 1911, an increase of 15,591 tons, or over 6%. Of the total in 1912 about 2,500 tons were iron, as compared with about 2,388 tons in 1911, and about 271,832 tons were steel, as compared with about 256,353 tons in 1911.

The following table gives the production by states of concrete bars in 1912, iron bars being separated from steel bars.

PRODUCTION OF REINFORCING BARS BY STATES IN 1912

	Iron, tons	Steel, tons	Total tonnage
Me., N. Y. and N. J.	....	69,755	69,755
Pennsylvania	....	73,639	73,639
Ga., Ala. and Texas..	....	13,005	13,005
Ohio		11,728	11,728
Indiana		21,902	21,902
Illinois	....	33,803	33,803
Mich., Wis. and Mo..	....	18,907	18,907
Col., Wash. and Cal..	2,500	29,093	31,593
Total for 1912 ..	2,500	271,832	274,332
Total for 1911 ..	2,388	256,353	258,741
Total for 1910 ..	1,641	[illegible]	[illegible]
Total for 1909...	....	159,352	159,352

In 1912 there were 36 plants in 16 states which rolled iron or steel bars for reinforced concrete work, as compared with 33 plants in 16 states in 1911. Pennsylvania made over 26.8% of the total production in 1912, against over 29.1% in 1911, and New York made over 24% against over 21.9% in 1911.

Catalogs and other Trade Publications

Hollow Wall Machines. Van Guilder Hollow Wall Co., Rochester, N. Y. [illegible]" x 5¼", paper bound, 54 pp., illust. This little booklet is a detailed, carefully and plainly presented handbook showing the operation of the Van Guilder hollow wall machine. The matter is presented very clearly and illustrated freely. Many interesting and valuable specifications and information of a general nature are given.

Keene Cement—American Keene Cement Co., Salt Lake City, Utah. 8¼"x4", paper bound, 20 pp., illus. The above company, which is about 4 years old, has a plant at Sigurd, Uath, where the company owns several hundred acres of gypsum deposits. Several grades of American Keene cement are turned out such as basic fine, superfine, casting extra superfine and coarse. The booklet describes all these in detail, presents direction for mixing and applying Keene cement and shows many interesting buildings where this material has been used.

Locomotive Crane with Grab Bucket Catalogue K—Brown Hoisting Mach'y. Co., Cleveland, 9"x6", paper bound, 56 pp., illust. This catalogue gives a general description of Brown hoist locomotive cranes of various capacities and the illustrations show how the cranes are used in connection with Brown hoist grab buckets. An introductory statement says that a locomotive craine equipment with a grab-bucket is equivalent to 20 men to 40 men in handling material such as coal, gravel, ashes, etc. The catalogue is profusely illustrated with many views of actual installations.

Little Wonder Concrete Mixer. Waterloo Cement Machinery Corp., 105 Vinton St., Waterloo, Ia. 9" x 6", paper bound, 16 pp., illust. This booklet describes in detail the small open-drum batch mixer manufactured by this company. Some interesting data are given covering the comparative cost of hand mixing and small batch machine mixing, and in light of the data shown it is no wonder, as has often been stated in these columns, that hand mixing is rapidly becoming a lost art. A small machine will do it better and more cheaply.

Hydrocide. L. Sonneborn Sons, N. Y. C. 6" x 3½", paper bound, 14 pp. This is a hydrocarbon compound which, when applied to masonry surfaces, produces a black, elastic and, the manufacturers state, impervious coating. The compound is of such consistency that part of it penetrates the masonry and part remains on the surface.

Marbleoid-Sanitas Fire-proof Flooring. Marbleoid Co., N. Y. C. 6¼" x 3½", paper bound, 24 pp., illust. The material described in this little booklet is a composition coating for floors, base, wainscoting, stairs, etc. This coating is applied upon any rigid foundation and is usually put on in two coats. The booklet describes the principal features of this floor material and lists many large buildings in which it has been used.

Portland Paint. Chickamaugua Cement Co., Chattanooga, Tenn., 6¼" x 3¼", paper bound, 8 pp., illust. This is a cold water paint in which the principal ingredient is Portland cement, which fact suggests the name. In the manufacture of this paint the cement is prepared with other selected minerals and silica and asbestos fibre are added. This composition is reduced to an extremely fine powder, equal to the finest dust. The manufacturers state that the Portland paint adheres strongly to brick, steel, concrete or wood. It is tinted to develop an artistic flat color.

The Pedestal Pile. MacArthur Concrete Pile & Foundation Co., N. Y. C. [illegible] paper bound, 10 pp., illust. This little booklet presents on five subsequent left-hand pages illustrations showing the different steps in [illegible] pedestal pile. [illegible] are given over to five brief sentences describing each operation. It is a unique and interesting catalog.

American Seal Cement Coatings. Wm. Connors Paint Mfg. Co., Troy, N. Y. 6½", x 3½", paper bound, illust. This folder states briefly what these cement coatings are, and [illegible] facturers state that these materials produce a tough and elastic coating, and that 1 gal. of material will cover approximately from 350 sq. ft. to 400 sq. ft. of surface. A primer manufactured by the same company is recommended for use.

Pavements and Roadways. American Steel & Wire Co., Chicago. 6" x 9¼", paper bound, 100 pp., illust. This is an excellent book with a great deal of information on concrete paving. It is primarily devoted, of course, to the use of Triangle mesh reinforcement.

Cork Brick Floors. Armstrong Cork Co., Pittsburgh. 7" x 5", paper bound, 40 pp., illus. This artistically prepared catalog presents detailed information on cork brick floors in dairy and farm buildings. Many interesting installations are shown.

Builders' Specialities. Van Expansion Bolt Mfg. Co., Chicago. 6¼" x 3¾", paper bound, 23 pp., illus. This is a convenient, well-arranged little booklet presenting an interesting discussion of expansion bolts in general and the "Van" expansion bolt in detail. An electrical welded form tie for wall centering is described and also a chair for anchoring floor sleepers in the concrete.

Ornamental Roofings for Residences. Patent Vulcanite Roofing Co., Chicago. 8½" x 6¼", paper bound, 12 pp., illus. This booklet describes in detail the application of the various kinds of "Vulcanite" composition roofings.

Rock Drills. Sullivan Machinery Co., Chicago. 9" x 6", paper bound, 56 pp., illus. This bulletin, punched for file binders, describes in a comprehensive manner all the features of the line of rock drills made by this company. Many interesting uses are listed and parts of the drill are listed in detail.

Waterproofing. Hydrozo Waterproofing Co., Kansas City, Mo. 6¼" x 3¾", paper bound, 20 pp. This material is a liquid, which, when applied to concrete surfaces, produces, the manufacturers claim, a non-oxidizing, impervious coating. Before application it is mixed with gasoline to produce a thin liquid and is applied with a brush. The catalog also describes Hydrozo stone tints.

Hy-Rib. Trussed Concrete Steel Co., Detroit. 7½" x 5½", paper bound, 112 pp., illus. This catalog, while presenting essential information on "Hy-Rib" sheeting, is especially interesting in that it shows many present day installations of this material with concrete on roofs. The dome of the presidential palace at Havana is one unusual installation shown. Other subjects covered are floors, partitions, sidings, ceilings, etc.

Cement Finishes. R. F. Johnston Paint Co., Cincinnati. 7" x 3¾", paper bound, 4-page folder. This little folder describes Johnston exterior finishes for concrete surfaces, and shows some samples of application.

Cork Tiling, The Ideal Floor. David E. Kennedy, Inc., N. Y. C. 7" x 5¾", paper bound, 24 pp., illust. This catalog describes cork floor tiling and shows many interesting installations of it in public rooms of various kinds. Construction details for floor, wall-base and step construction are shown.

Pneumatic Tools. Monarch Pneumatic Tool Co., St. Louis, Mo. One-page circulars. 6" x 9¼", illust., paper. This is a folder enclosing several 1-page circulars describing the various pneumatic tools made by the above company. Pneumatic hammers and drills are useful in many ways around concrete work. Hammers are used in bush-hammering concrete surfaces and drills are used extensively in drilling for expansion bolts.

Drawing Supplies and Engineering Instruments. F. Weber & Co., Philadelphia. 6½" 4½", paper bound, 280 pp., illust. This is a handy catalogue easily filed and lists in a convenient way a comprehensive line of engineering and drafting instruments.

Kompolite. General Kompolite Co., N. Y. C., 10" x 7", paper bound, 32 pp., illust. This catalogue shows the factory where "Kompolite" is made, and describes briefly what "Kompolite" is and how it is laid. As stated, this is a [illegible] Specifications for laying this material are giv-

[illegible] The bulk of the catalogue is devoted to illustrations of modern buildings where this material has been used.

Bulletin 52. New York Cement Gun Co., N. Y. C. 11" x 8½", paper bound, 4-page folder. This folder rescribes in detail some interesting repair work done with the "Cement Gun." The illustration shows work on retaining wall, concrete chimney and on bridge abutments.

Protecting Steel Work. New York Cement Gun Co., N. Y. C. 11" x 8½", paper bound, 4-page folder, illust. This shows in particular the work of the cement gun in protecting structural steel. A photograph of the cement gun at work on the Woolworth building is shown.

Stone Making. The Pettyjohn Co., 629 N. Sixth St., Terre Haute, Ind. 9" x 6", paper bound, 48 pp., illust. The salient feature of the Pettyjohn block machine is the fact that the machine itself, a very small, compact mold, is taken off of the block and moved to another pallet, instead of moving the block away from the machine. The catalogue, after describing Portland cement, its use and abuse, and the advantages of hollow concrete buildings, presents the essential features of the Pettyjohn machine. Different styles of block and different ways of handling the machine are covered in detail. Other equipment made by the Pettyjohn Co., such as fence post molds, sidewalk block machines, veneer molds, is described in this catalogue.

Unit Method of Construction. Unit Construction Co., St. Louis. 9¼" x 6¼", paper bound, 32 pp., illust. This is a very well arranged and artistically prepared catalogue presenting in detail the essential features of "unit" concrete construction. Many illustrations show the methods used in pouring and placing the units. Many completed buildings are also shown.

Concrete Bridges, Roads and Curbs. Trussed Concrete Steel Co., Detroit. 7½" x 5½", paper bound, 48 pp., illust. This catalogue presents in a neat and concise manner the materials made by this company, which are used in highway and bridge work. Joint and corner protectors are described and many interesting data are presented covering the design and construction of highway bridges, both girder and arch, box culverts and bridges in general.

Sound Transmission in Buildings. Hydrex Felt & Engineering Co., N. Y. C. 9" x 6", paper bound, 24 pp., illust. A technical and comprehensive discussion of the theory of sound transmission in building introduces this interesting catalogue. "Saniflor," a blanket-like, thick felt coated on its two surfaces like enameled leather is described, and its use as a sound-insulating material is shown in many detailed sketches.

Composition Capitals and Brackets. Frank A. Seifert Plastic Relief Co., St. Louis. 12" x 9", paper bound, 78 pp., illust. This catalogue shows in detail an extensive line of composition capitals for columns. Many artistic designs of columns and capitals are shown.

Plastic Relief Ornaments. Frank A. Seifert Plastic Relief Co., St. Louis. 12" x 9", paper bound, 126 pp., illust. This catalogue shows in detail a great number of designs for molding rococo ornaments, torches, rosettes, centers, frieze ornaments, cornices, and panel decorations. Other lines shown are vases, urns and also panels and various architectural motifs.

Electric Motors in Wood-Working Plants. Fairbanks, Morse & Co., Chicago, 9" x 6", paper bound, 24 pp., illust. This bulletin, punched so that it can be used in permanent covers, describes the use of electric power in wood-working plants. Complete equipments are specified and many illustrations are shown of interesting installations.

Duplex Pumps. John H. McGowan Co., Cincinnati. 9¼" x 4", paper bound, 8 pp., illust. This catalogue describes pumps especially fitted for boiler feed and tank pumps. The 'Duplex" pump is mounted on one base, with the power cylinder and the pump cylinder placed axially.

Sawing Machinery. Beach Mfg. Co., Montrose, Pa. 6" x 3½", paper bound, 8 pp., illust. This is a little folder describing sawmill machinery. A double arbor rip- and cut-off saw is an interesting feature.

Pumps. A. S. Cameron Steam Pump [illegible] paper bound, 16 pp., illust. In all construction work under water or near water, concrete is used almost exclusively, and this means that all contractors doing such work must use pumps. The pumps described in this catalogue, which covers a long etablished line, were used extensively on the Catskill aqueduct. The catalogue describes the line in detail.

Double Wall Construction. Van Guilder Hollow Wall Co., 728 Ch. of Commerce Bldg., Rochester, N. Y. 9" x 6", paper bound, 4-page folder. This folder sums up very briefly and concisely comparative costs of different wall construction. The data presented should be of information to all builders.

"Trusswall" Columns. Trusswall Mfg. Co., Kansas City, Mo. 10½" x 7", paper bound, 4-page folder, illust. This describes a method of making concrete units by which they are turned on a lathe using a collapsible core as a mandrel. This product is rapidly becoming standardized and much interesting work is shown.

Pneumatic Mixer and Conveyor. Pneumatic Concrete Placing Co., N. Y. C. 9½" x 6¼", paper bound, 20 pp., illust. This catalogue describes pneumatic equipment which mixes and conveys concrete. The description of the operation of the equipment is presented in detail, together with many interesting illustrations showing its work on recent construction.

Clam Shell Buckets. Owen Bucket Co., Cleveland. 10" x 7½", paper bound, 24 pp., illust. This catalogue after briefly describing the Owen bucket and its construction and operation, is devoted to many illustrations showing various uses of the bucket on actual work. An interesting page is devoted to detailed instruction covering the reeving of the blocks in the bucket.

Protective Paints. Semet-Solvay Co., Syracuse, N. Y. 7" x 5", paper bound, 32 pp., illust. While this catalogue describes a general line of attractive paints, CONCRETE-CEMENT AGE readers will be interested in "Solvay" concrete coating which, the catalogue states, is a heavy black bituminous paint designed to waterproof outside walls, cellar floors, etc.

Report of Test. Reinforced Concrete Pipe Co., Jackson, Mich. 12" x 9¼", paper bound, 10 pp., illust. This pamphlet presents an engineering report of a test of concrete pipe made in 1910. The test is fully illustrated.

Crescent Wood-Working Machinery. The Crescent Machine Co., 115 Columbia St., Leetonia, O., 6" x 4", paper bound, 128 pp., illust. This is a neat little catalogue presenting in a compact and comprehensive manner essential information covering a complete line of woodworking machinery. Much of the equipment used is of interest to concrete builders.

Incline Railways. Otis Elevator Co., N. Y. C. 9" x 6", paper bound, 28 pp., illus. This catalogue presents in a very interesting way a comprehensive description of inclined railways for tourist and passenger use, for traffic incline and for commercial work. The subject is very attractive, and the booklet

Unit Costs on Steam Shovel Excavation Job.

One great advantage of the weekly cost sheets made out on its various jobs by the Aberthaw Construction Co., Boston, is the fact that unnecessarily high costs in any one part of the work are detected and corrected before they have gone far. By thus knowing in detail just what such work costs, this company is enabled to make correct bids, where a less well informed contractor would be likely either to take the work at a loss or to figure an excessive charge for it.

As an example of this method of cost keeping and its working out in service, an excavation job in New Hampshire, on which 8,022 cu. yds. of material were removed from the side of a hill to make way for a building foundation, the cost figured out at $0.375 per cu. yd. This work was done with a ⅔-yd. Thew[1] steam shovel, and showed a saving of probably 8 cts. per unit, as compared with hand-work. At the same time, it should be remembered that a great deal of railroad excavation is done at a cost of 5 cts. or 6 cts. per cu. yd., and many contractors would have bid 20 cts. or 25 cts. on the job in question—and lost money.

An analysis of the figures in question shows that labor alone (around the shovel, pushing and unloading the dump cars and spreading the material at the dump) accounted for practically 23 cts. per cu. yd. of total material handled. The items of rental of shovel and track, repairs, etc., were so small that figuring on these as a basis, a much lower figure than that obtained would have been bid by an inexperienced contractor. This shows in a very clear way the advantage of an exact cost accounting system on jobs of this sort, as a guide to future work.

Most of the material was dry gravel, with a small percentage of boulders. It was carted off in dump cars pushed by hand back and forth on a standard contractors' track (500 ft.) carried on a trestle about 10 ft. above the ground. The average haul was about 400 ft.; the shortest haul, 200 ft. The unit costs are shown in the following table:

UNIT COSTS ON STEAM SHOVEL EXCAVATION

Labor around shovel, pushing cars, unloading, and spreading at the dump	22.9c	per	cu.	yd
Repairs $1[illegible], Rental of shovel $3[illegible]	1.5c	"	"	"
Labor on track including 10 ft. high trestle	3.5c	"	"	"
Labor for unloading, placing, etc., at the job	3.1c	"	"	"
Rental of track	1.1c	"	"	"
Labor at Boston end (including shippers' bills)	1.25c	"	"	"
Freight on shovel and parts (both ways)	0.85c	"	"	"
Total	37.5c	"	"	"

Facts Nailed Down—General Fireproofing Co., Youngstown, Ohio, 6" x 3½", paper bound, 16 pp., illust. This bulletin brings out strongly the rust-resisting properties of pure iron and illustrates this in many interesting ways. Detailed information in regard to "Herringbone" ingot iron lath is given.

Pressed Steel Ceilings and Walls. Edwards Manfg. Co., Cincinnati. 9" x 6", paper bound, 66 pp., illus. This catalogue shows in detail the possibility of pressed steel ceilings and walls. A cover design in four colors makes a very attractive appearance. A complete line of patterns is shown.

The H. W. Johns-Manville Co., N. Y. C., has opened a new office and warehouse in Galveston, Tex. At present time this concern has three offices in Texas, viz., at Houston, Dallas and Galveston. At the last named place, in a modern brick warehouse of large proportions, will be consolidated the stock for distribution to the different offices and throughout the firm's Texas territory.

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[1] Thew Automatic Shovel Co., Lorain, O.

Concrete-Cement Age

Vol. III DECEMBER, 1913 No. 6

Editorials

AN ARTICLE in this issue shows how an Egyptian railway company struck what seems to be rock bottom in the cost of concrete cottages. Homes were needed for native employees whose salaries also seem, from our standpoint, very low. The engineers of the company designed and carried out the work in concrete using large unit construction, casting an entire side of a house horizontally at one operation. The corners were grouted in after the projecting steel reinforcement had been laced together and a galvanized iron roof completed the structure. The three-roomed unit was built for $195.

* * *

CONTRASTS are made more striking by their proximity. Near Winnipeg, a great grain elevator, too heavy for its foundation, settles about 20 ft. and inclines to about 30° from the vertical. It is structurally intact, and will be straightened up, placed on new foundations and be as good as ever. In Cedar Rapids, Ia., a reinforced concrete building, nearing completion, collapses. What might have been a section of a permanent building becomes a mass of tangled death-laden wreckage in the basement.

Cement, stone, steel and sand are not made into concrete by mixing alone. Time is a factor, a vital factor, and so is temperature. These materials must set and set hard before they become concrete. Nov. 14 last, in Cedar Rapids, a 20-ft. unsupported span on a fifth floor—31 days old, was called upon to carry the dead load, a punching shear load, of a sixth floor, 22 days old, a seventh floor, 13 days old, and the construction load of the roof, practically another floor. The load was not distributed, but was carried on vertical shores, resting on blocks. The floor failed and down with it came the entire rear section of the building. Was this, speaking accurately, a concrete failure?

Is a carload of dynamite, going off accidentally, a *dynamite* failure? Was the Quebec bridge a *steel* failure? Why should a construction accident where concrete is used be a concrete failure? Isn't it rather a failure of workmanship, of judgment, of sound common sense?

The leaning tower of Pisa is a world wonder. Are not the leaning elevators at Transcona, a much greater wonder, and is not the wonderful structural efficiency of reinforced concrete, rightly handled, emphasized all the more by contrast with the same material, poorly handled?

* * *

WE have been studying the matter of making the contents of CONCRETE-CEMENT AGE more available for the reader. That is, we have been trying to solve the problem of presenting the articles which are published each month so that they will receive the attention of the man who is interested. CONCRETE-CEMENT AGE covers a wide field and we cannot expect that every article which is published will be of equal interest to every reader. The problem is to present matter in such a way that every reader can get at what he *is* interested in. Some typographical changes will go into effect with the January issue which we feel sure will make your magazine more efficient. We call your attention in advance to matter which will be published in January on the second page inside the cover; that is, on page 4 of the advertising section. This page will virtually carry the Editorial Department's advertising each month. We suggest that you form the habit of scanning this page.

* * *

Concrete Responds to Intelligent Supervision

The important fact that the making of concrete in building construction is a manufacturing and not a construction operation has been repeatedly emphasized in the columns of this journal. While practically all the materials entering into the construction of a large edifice come to the job in their finished state—after careful manufacture and scientific examination and preparation at the site of their production, the case of concrete differs from all the others in the fact that it—as a finished building material—is actually made on the work itself.

With this thought in mind and with a knowledge shown in his recent paper before the A. S. C. E. on "The Effect of Saturation on the Strength of Concrete," J. L. Van Ornum, M. Am. Soc. C. E. calls attention to the remarkable effects on concrete as a result of saturation. Admitting that the cause alone in its effects on dry or partly dry concrete is "amply covered by the factor of safety required by good practice if it be the only fault," the author says: "Nevertheless the materials may be considerably below standard, or the workmanship may be defective, or the design may encroach on the reserve of safety, or the occasional overload may be imposed; and if the material man, the construction superintendent, the designer, and the user of the structure should each rely on the others to meet fully the requirements, in the expectation that his own delinquency will be safely covered by the factor of safety, it would not require an impossible coincidence of such conditions to cause disaster; especially in view of the fact that considerable variations from the average strength values, which form the basis of design, necessarily exist in different parts of the structure. In fact, the failures which have occurred are generally a result of several such contributing causes."

This important statement by the author brings him to the point referred to above, one which has been mentioned by us many times namely "that differences in control (which to the average artisan are seemingly unimportant) actually do exert a positive influence on the essential characteristics of concrete and actually constitute a definite warning against entrusting it to the uncertainties of irresponsible or skeptical supervision and assure an ample reward for competent control which is correctly adapted to develop its capabilities."

Instancing the comparison that we have made on many occasions between steel, brought in its finished form upon the work in which it is to be used, and the concrete which is made on the work itself, the author emphasizes this important difference by saying:

"The susceptibility of steel to the influence of phosphorus and sulphur, of details of its heat treatment, and of other conditions occuring in the process of its manufacture, has resulted in restricting its production to the scrutiny of expert superintendence. Equal reason exists for, and commensurate advantages will follow, a thoroughly discriminating control of both the initial fabrication of concrete and the details of treatment during its hardening, in order to realize the great possibilities inherent in this newer material.

"The treatment of steel is not always complete as it comes from the rolls, as is shown by such effects as the changes in strength produced by the cold-twisting of steel rods; much more important in relation to the resulting quality of concrete is the nature of its treatment after fabrication, both because its attainment of strength is a relatively slow process and for the reason that the nature of the prevailing conditions provided during this period affects so greatly the development of its essential properties.

"The notable responsiveness of concrete to the character of its treatment is a direct appeal for thoroughly trustworthy and expert control."

* * *

Value of Sand-Cement on Isolated Work

It is interesting to read in these days of the return to the old practice of sand blending of cement, a method now being used with great success on the Elephant Butte dam by the U. S. Engineers in charge of that important work. This dam is being built about 12 m. west of Engle, a small town on the Santa Fe R. R., 110 miles north of El Paso, Tex. This blended cement, under the name of silica cement, was originally patented in Europe and subsequently introduced into this country nearly 20 years ago, but, owing to various commercial difficulties and to lack of demand for cement of that character in the general markets, the enterprise was discontinued.

Among the first works for the production of a blended cement, or silica cement as it has been called, was the plant established on Long Island near N. Y. C., where many hundreds of thousands of barrels were made and distributed in the metropolitan cement market. Subsequently a plant operated on the same general lines was established in Chicago. The difficulties that were met with at the time were those attending the introduction of any material not coming up to what were the then standard specifications. The admixture being admitted, it was nevertheless alleged that those cements were adulterated forms of Portland cement.

Modern practice, as described at the Elephant Butte dam, is predicated upon another state of facts, namely, the advantage of using sand-blended cement in places far distant from transportation facilities, where sand can be had, though the cost of Portland cement is high. These sand-blended cements, as shown by records dating back many years, have great strength, and where ground in tube mills to the requisite fineness of Portland cement carry, in addition to the sand-forming part of their composition, a large admixture of the ordinary building sand. The same objection to the use of sand-blended cements in the general commercial markets apply now as applied when the commercialization of the product was first attempted, but there is no reason at all for not using materials of the character described under the conditions prevalent in government work of the Irrigation Bureau and other projects where transportation costs of cement form a material element in the cost of concrete or masonry.

This method is far preferable to the construction of Portland cement works by the government as was the case at the Roosevelt dam, and as the plant required to make these sand-blended cements is inexpensive as compared with a modern Portland cement plant, the loss by depreciation by the ultimate destruction of the plant at the completion of the building project is much smaller than in the cases where Portland cement works have been constructed.

* * *

Hands Down In Wet Concrete

Some time ago in CONCRETE-CEMENT AGE there was a story of how a California house owner decorated the concrete floor of the patio or courtyard by impressing therein while it was green, branches of plants growing in the garden. The cement finishers on the work were somewhat dubious when they were instructed to pat down and trowel in the arching foliage, but when they found that they could take it out easily, leaving the delicate impression of the branch they became enthusiastic about it and carried the design as a border around the courtyard.

Along a similar line is the practice followed by another home-builder in California, who hit upon a unique idea when he caused his little son, a good many years ago, to make the impression of his hands in the wet concrete of the walk before his door. This was done in 1887, but the outlines of the little hands are perfectly clear today and will remain as a pleasant souvenir of the boy's play days. It is just such touches of sentiment as this that make the difference between a house and a home, and always concrete is *the* material.

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Goose-Neck Bars for Centering Work

Goose-necked bars 30 ins. or so long are very handy indeed for placing centering panels for building forms, etc. They can be made with the gooseneck bent to a 2-in. radius with the end hammered to a chisel edge, and split with a "V" so that nails can be pulled. The straight end should be given a slight pitch so that it will pry better. These can be purchased at any hardware supply store, but for use on a job where several handy men are equipped with them a good way is to take short pieces of ⅝-in. or ¾-in. round or square reinforcing bars and have a blacksmith make them at a low cost. These bars come in handy on the work.

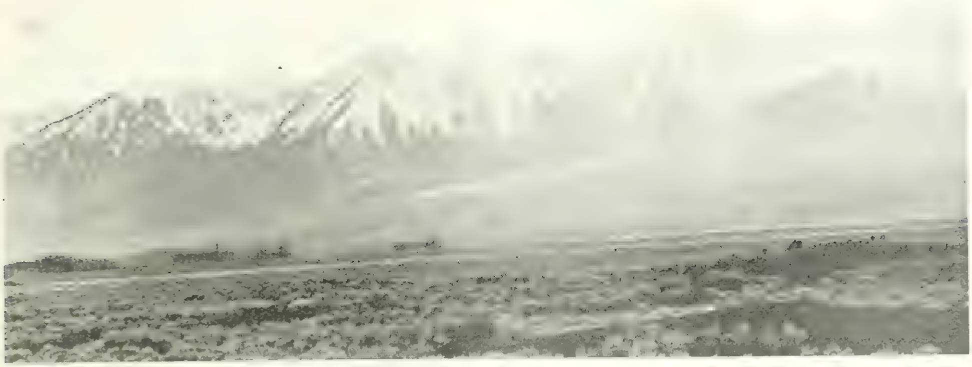

Fig. 1. Eastern Slope of the Sierras. The Watershed of the Owens River

Story of the Los Angeles Aqueduct

An Account of How a Great Engineering Work Was Undertaken and Worked Out

BY HENRY Z. OSBORNE*

OUR CURRENT PERIODICALS, *the dailies and the weeklies, recorded recently the formal opening of the Los Angeles Aqueduct. The following notes by one who was actively identified with the work from the start tell the history of the aqueduct, from inception to completion.*

Our readers are designers and builders of concrete, and usually look to our pages for the HOW of concrete work. This qualification is the guiding idea of our editorial work.

The following article, however, is in a way an exception to our usual practice, for it goes behind the construction of a great engineering work, and shows in detail the developments which made the Aqueduct possible.

Pure water is a vital necessity in every community; and more important in a way than the actual engineering and structural details of any such work, are the social forces and ideals, the aggressive comprehensive work, expressions of the common need, which make possible such a great public work as the Los Angeles Aqueduct.

The following article presents this phase of the matter, and what has been done in Southern California on a grand scale, could be done anywhere on the scale required. Public spirited and social-minded men believed in concrete and a concrete engineer, and the Los Angeles Aqueduct is a reality.

The Territory

Owens river valley, although one of the most extensive and promising from an agricultural standpoint of the lesser valleys of California, is one of the least known. Owens river valley geographically is more of a Nevada valley than one of California. The river from which it takes its name in its southern course parallels the main range of the Sierra Nevadas, and has its source in and derives its waters from these grand mountains.

The Sierra Nevadas, throughout their northerly and southerly course, nearly 1,000 miles, are extremely abrupt on their eastern slopes, and fall away gradually and gently to the west, toward the Pacific Ocean, several of the highest peaks rising abruptly from the plains on the eastern flank of the range.

The snowfall is extremely heavy in the high eastern side of the Sierras, and nearly every canyon carries fine streams of water throughout the year; these streams are veritable rivers in the spring and summer months when the winter snows are melting. Thirty-five such streams empty into the Owens river from a drainage area of 2,800 square miles.

On the high and sequestered parts of the mountains the snows never entirely disappear, but are held from one season to another as living glaciers. Lakes of large size are formed by the waters from the mountains; lakes which have no outlets, like Mono Lake in Mono County, and Owens Lake, 200 miles further south, in Inyo County.

To witness the enormous quantity of water that pours into these lakes, one would think that, with no visible outlets, they would eventually cover vast areas. But by means of the excessive evaporation of a naturally dry country, which is said to amount to 90" per year on the surface of the lakes, the equilibrium is prettty well maintained, and while there is sometimes a raise for several successive years, and in Mono Lake the writer has seen fences inclosing former meadows, covered 5' or 6' with water, lighter snowfalls are likely to reduce it in subsequent years to its former level.

One of the well known phenomena of Mono and Owens Lakes is that they are excessively mineralized, the evaporation leaving the salts in the water. The result is that water that flows into the lakes as fresh and pure as it is possible to be, coming direct from the snows, quickly becomes brackish and unpotable; nor can it be used for irrigation or any other purpose, except that in a limited way the salts have been abstracted at Owens Lake. This lake has a superficial area of 75 sq. miles, while Mono Lake is much larger.

Owens River has a length of about 150 miles. Its waters are made up altogether of the snow waters from the Sierras. The valley itself is from two or three to 10 miles wide, bounded by the Sierra Nevadas on the west and by Inyo Mountain range on the east, and sufficient water flows in the river to irrigate all this valley, with an overflow into Owens Lake, where it performs no useful service, of sufficient volume to supply a city of 2,000,000 people with an ample quantity for domestic use.

It was to this source that Los Angeles turned when it was foreseen that there

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*Former President of the Los Angeles Chamber of Commerce

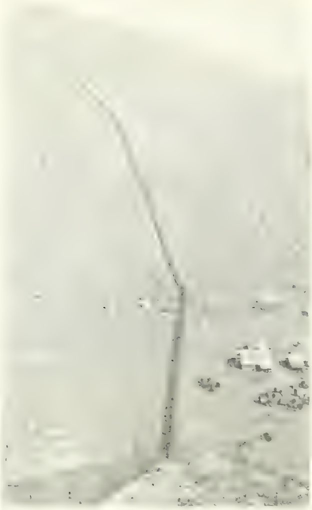


Fig. 1—The North End of the Jawbone Inverted Siphon

might in the course of its rapid growth be a shortage in the indispensable water supply.

The Man

Having described the Place, let us take a look at the Man—because with every Big Job there is a Big Man to carry it out. In the case of the Panama Canal, it is Col. Goethals. In that of the Los Angeles Aqueduct, it is William Mulholland. Unlike Goethals, he did not have the advantage of early scientific training. William Mulholland is a scholarly man, with a diversified knowledge of the widest range; but his education and engineering skill were not gained in schools or colleges, but were acquired by constant reading and study under most unfavorable conditions. His Irish parents conferred upon him a vigorous and rugged physique, a fine sense of right and wrong, and a humorous and practical turn of mind. A remarkably retentive memory enabled him to hold the knowledge that his habits of uninterrupted study brought to him.

William Mulholland, born in Ireland 57 years ago, came to the U. S. when 20 years of age, and two years later he arrived in Los Angeles not essentially different from any other poor Irish lad, with ten dollars in his pocket, an abundance of good health, optimism and ambition. His first work was in assisting in sinking artesian wells. Six months later he became a "zanjero," or ditch-tender, for the Los Angeles City Water Co., which at that time had a lease of the city water supply, and furnished the city with water for domestic use and irrigation. It was his duty to patrol the open ditch which served Los Angeles, and keep it cleared of weeds and impurities. The first three years of his employment he had a cabin in the upper reaches of the Los Angeles river bottom, where he lived alone, faithfully watching the zanja by day and reading and studying engineering and other scientific books by night, reserving for sleep only such time as was necessary. He was advanced step by step until he became superintendent and chief engineer of the company. The growth of the city had rendered necessary a large equipment, and he supervised the job of reconstruction of the works. The lease to the water company having expired, the city resumed its control of the water system in 1902, and Mr. Mulholland was retained as chief engineer by the non-partisan Water Board which was placed in control by the city.

A Gigantic Enterprise Finished

The completion of the Los Angeles Aqueduct, now an accomplished fact, marks the successful ending of one of the most gigantic struggles with obdurate Nature in her most rugged aspects of mountain and desert, and with powerful and subtle private interests, for the possession of water, that has ever been recorded in the world's history. The 10 aqueducts of ancient Rome were marvels of engineering skill and durability; but their construction stretched over a period of five centuries, against the eight years that have elapsed since the Los Angeles Aqueduct was first proposed, and the length and dimensions of the ancient Roman aqueducts bear no comparison with that of modern Los Angeles. The longest of the Roman aqueducts was 62 miles, while the Los Angeles Aqueduct is 250 miles in length, from the intake on Owens river to the city limits of Los Angeles. The irrigation aqueducts of the Inca Indians of ancient Peru, one of which was 360 miles long, are among the wonders of the world, especially so when it is considered that they were constructed by a people uninformed as to modern engineering science and its methods, but these undoubtedly exhausted centuries of time. The 350 miles of iron pipe line, 30" in diameter, which convey water across the arid plains of Western Australia to the gold mining districts of Kalgoorlie and Coolgardie, form one of the triumphs of modern constructive hydraulic engineering; but this construction, although in a hot and waterless country, was comparatively level, while the Los Angeles Aqueduct bores through miles of mountains of solid rock, crosses valleys on pillars of concrete in some places, and through immense steel siphons in others, and is of vastly greater dimensions than the notable Australian structure.

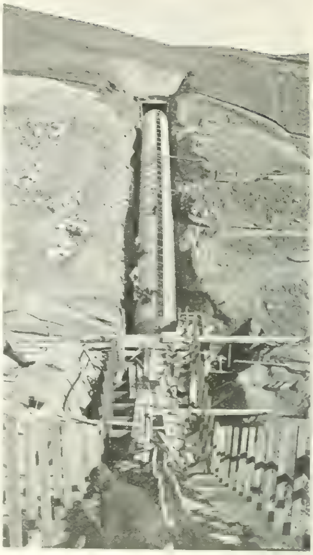


Fig. 3—Concrete Approach Antelope Valley Inverted Steel Siphon

A Comparison With the Catskill Aqueduct

The great Catskill Aqueduct to supply the city of New York, is the only modern hydraulic enterprise intended mainly for domestic and industrial use, that compares fairly with the Los Angeles Aqueduct. The New York

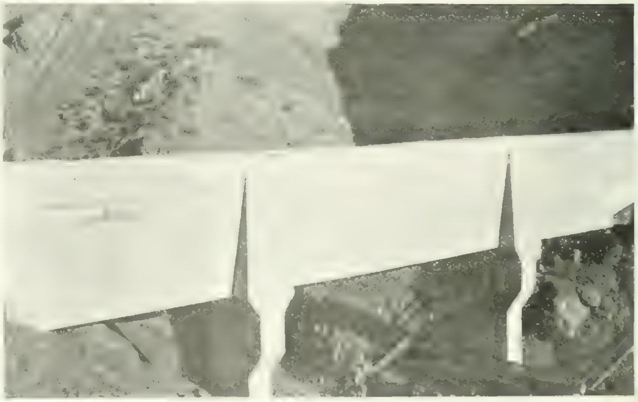


Fig. 4—Small Dry Washes or Little Gulches are Crossed by the Aqueduct in Concrete Flumes of Monolithic Construction

Aqueduct crosses the Hudson far beneath the river bed, and will furnish the metropolis with less than 25% greater quantity of water than will the California conduit, at a cost, including its various reservoirs, of about $165,000,000. The Los Angeles Aqueduct is about twice as long, passes through an incomparably rougher country, and will cost, when completed, less than one fifth as much as the great New York enterprise. The capacity of the Catskill Aqueduct will be 500,000,000 gals. each 24 hrs., while that of the Los Angeles Aqueduct will be 265,000,000 gals.

Inception of the Aqueduct

The present site of the City of Los Angeles was selected by its Mexican founders in 1781, because of its proximity to the Los Angeles river, from which it received its supply of water for domestic use and irrigation purposes. The waters of the river, a small stream ordinarily, but with an extensive drainage area, were granted in perpetuity to the "Pueblo de Nuestra Senora de Los Angeles"—the City of Our Lady of the Angels—by the Mexican government. The first settlers numbered 44 humble pobladores, or colonists, from Mexico. They and their successors for the intervening 132 years, now comprising a city of a half-million people, have drawn their supply of water—and very good water it is—from the Los Angeles river. The deep gravel deposits of the San Fernando Valley and of the coastal plain, gathering the saturation of centuries, constituted a reserve supply of importance.

The average rainfall at Los Angeles for a long series of years, as reported by the U. S. Weather Bureau, is between 15" and 16". The seven seasons from 1893-1894 to 1899-1900 were as a whole very dry, and yielded altogether but 68.77" of rainfall, or an average of 9.82" per year. The two seasons of 1894-1895 and 1897-1898 were average seasons, each with a record of over 16"; but the average of the other five seasons was but 7.16". That this was no permanent condition, and that the pessimists who felt sure that "the climate is changing," were wrong, is evidenced by the fact that in the following seven seasons, from 1900-1901 to 1906-1907, the total rainfall was 112.40", or an average of 16.06". During the "seven dry years," however, the flow of the Los Angeles river gradually decreased, while the population of the city and county increased very rapidly. The orange growers and other horticulturists and ranchers attacked the "reserves," by boring wells into the underlying gravels, and by applying powerful gasoline pumps, [illegible] secured an ample supply for their present needs, and very largely extended their area of irrigated orchards and cultivated land. The season of 1903-1904 was one of light rainfall—8.72". A series of measurements made during several years by the United States Reclamation Service showed that the level of underground water had lowered very considerably. William Mulholland, [illegible] of the Los

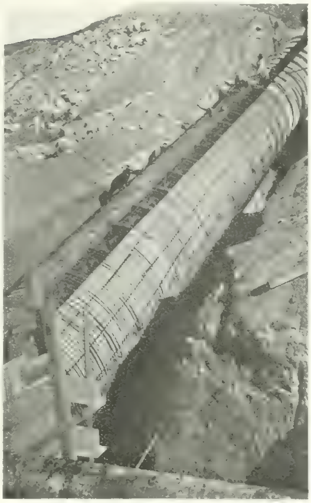


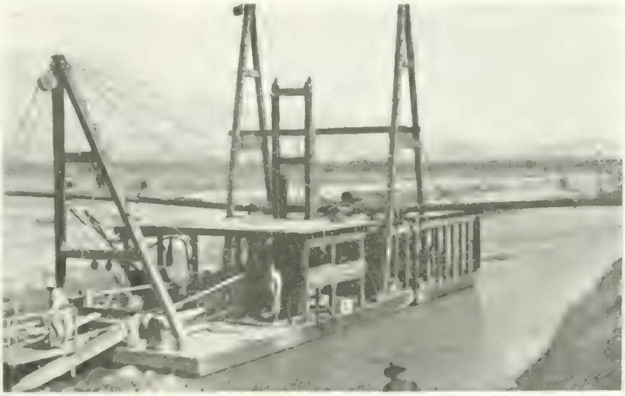
Fig. 5—Ellsmere Reinforced Concrete Siphon

Angeles Water Dept., in an address before the Sunset Club, an organization of men deeply interested in the welfare of the city, in the summer of 1904, set forth these important facts as to the diminution of the water supply, and the necessity of bringing in a largely increased quantity from an ample and unfailing source, if Los Angeles was to continue the great growth that it was then enjoying. He intimated that such a supply of pure mountain water had been found, and that as soon as options had been obtained for the purchase of the necessary water rights and lands, the information would be made public.

Getting the "Jump" on Land Speculators

Fred Eaton, a former city engineer and subsequently mayor of Los Angeles, had spent some years of his earlier life in the Owens river valley of Inyo county, and to his alert mind probably first occurred the idea of Owens river as a source of the permanent water supply of Los Angeles. He presented the subject to the Bd. of Water Commissioners and to Chf. Engr. Mulholland, and the latter was sent with Mr. Eaton to look over the ground. Upon his return Mr. Mulholland made a favorable report upon the project. It was then that a most venturesome thing was done by the Bd. of Water Commissioners—an action which might be described as a "war measure;" one which a less courageous body of men, or one less firmly grounded in the sincerity of its own intentions and less sure of the final results, would not have ventured to do. Without other authority than their confidence that their action would subsequently be ratified by the people of the city, the Bd. directed Mr. Eaton to obtain options on the excess waters of the Owens river and on all the lands in the valley that might be needed to carry out successfully the plan to divide the flow of the river, and transfer 20,000 miner's inches to the City of Los Angeles, 250 miles away. It was necessary that this delicate work of securing the options should be done by a private citizen, with as little publicity as possible, because if it had been known that the city of Los Angeles was the intending purchaser, the lands would have been advanced to a prohibitive price. Had the matter come regularly before the City Council, this publicity would have been inevitable. Speculators would have secured options ahead of the city; prices would have gone skyward, and, in short, Los Angeles never would have received the water.

Fred Eaton, as one thoroughly acquainted with the valley and its people, was authorized to negotiate the options, and the Water Board advanced the amounts necessary to procure them. About 90,000 acres were "tied up" in this way, this acreage controlling about 265,000,000 gals. of water per day. In June, 1905, the public of Los Angeles was apprised by a simultaneous publication in the daily newspapers that it was the potential owner of 90,000 acres of land in Inyo county, 250 miles distant, and of a priceless right to a sufficient quantity of pure mountain water



[illegible]

to supply amply a city of two millions [illegible]

Money Provided for the Work

[illegible] with the bold steps that had been taken by the Water Board upon the recommendation of Ch. Engr. Mulholland, that their action was confirmed by a vote in the ratio of 14 to 1 in September of the same year, upon the question of authorizing bonds to the extent of $1,500,000 to pay for the 90,000 acres of land and water rights, and for preliminary surveys and engineering investigations. The average cost of these lands was $14.60 per acre; since that time similar lands in the valley have been sold to private purchasers at $200 per acre.

Ch. Engr. Mulholland prepared plans and estimates for the construction of the aqueduct in 1906, and the City Council authorized the employment of a board of three eminent hydraulic engineers to examine and report upon the whole project. This board consisted of John R. Freeman, cons. engr. of the great Catskill Aqueduct of New York; James D. Schuyler, one of the engineers appointed by Pres. Roosevelt to report upon the Panama Canal, and Frederick P. Stearns, former president of the A. S. C. E. They made a careful examination of the project, and on Christmas Day, 1906, they reported that they had been over the entire course of the proposed aqueduct, had examined Mr. Mulholland's plans and estimates, and they found them sound and practicable, and they agreed with his estimate of $23,000,000 additional as the cost of the aqueduct, exclusive of any expense for developing electric power. Six years was estimated as the minimum of time that would be required to conclude the work.

Fierce Attack on the Plan

About this time there developed the fact that the aqueduct was not to be constructed without a bitter contest, all the more dangerous because the attack was from masked batteries. A half dozen or more projects sprang up, one after another, to supply Los Angeles with water from various sources, at less cost than from Owens river. All these projects had been examined years before, and found inadequate. There was delay after delay in fixing the time for the election on the issue of $23,000,000 bonds. The report of the eminent hydraulic engineers was accepted by the great majority as conclusively in favor of the Owens river project, and finally the election was set for June 12, 1907. This was one of the most critical periods in the history of the aqueduct. A persistent and bitter campaign was made against voting the bonds, evidently inspired and fostered by powerful private interests. All sorts of arguments were used, often of a contradictory nature, but all intended to weaken the public faith in the enterprise. It was declared upon engineering authority that the cost would be $50,000,000—more than twice Mr. Mulholland's estimates—and that it would bankrupt the city. The Owens river water was insufficient in quantity, it was impregnated with alkali, and it would all evaporate before reaching Los Angeles. It would take 20 years to construct the aqueduct instead of six, the 50 miles of tunnels were impossible, and the gravity system of Mr. Mulholland was therefore impossible, and the water would have to be pumped over high mountains at prohibitive cost. To guard against the dangers from earthquakes, two aqueducts would have to be built at enormous cost. Steel pipe throughout should be used instead of cement-lined conduits. Mulholland was a sage-brush engineer (he is now recognized as one of the great hydraulic engineers of the world), and he never had a diploma from any university or scientific school.

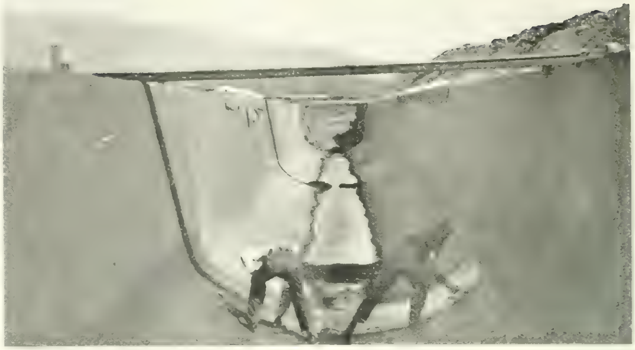


Fig. 7—Surfacing a Section of the Conduit; The Cover is Yet to be Placed

The Los Angeles Chamber of Commerce and other civic bodies, with a view to preventing a stampede of the people by these specious and adroitly-presented objections, declared their belief in the Los Angeles Aqueduct, and in Chf. Engr. Mulholland's plan, and advised the people to vote the bonds. To the credit of the sound sense and courage of the people, they voted the $23,000,000 bonds, in spite of the vicious opposition, by more than 10 to 1—or, to be exact, by a vote of 21,918 to 2,128.

Legislative obstacles were encountered, however. The government was asked to retain lands in the valley needed by the city, and this failing, a bill was introduced into Congress providing that in granting Los Angeles a right of way for the aqueduct over public lands the privilege should be confined to the conveyance of water for "domestic use." This restriction would have been fatal to the full use of the aqueduct. The Los Angeles Chamber of Commerce again took up the fight, and sent a committee of its leading members to Washington with Chf. Engr. Mulholland and the City Attorney, to interview the President. Senator Frank P. Flint secured them an audience with President Roosevelt, and the situation was frankly placed before him. The President took a friendly interest in what at once impressed him as a big, useful and courageous enterprise, and his vigorous recommendation resulted in cutting out the restricting clause, and Los Angeles was given a free right of way through government lands, under most liberal conditions.

The obstructors turned their attention to the State capital, and an innocent-appearing bill was introduced in the Legislature at Sacramento providing for a minimum wage of $2.50 per day on all public work. Now, 80% of the cost of the aqueduct was for labor. To have added 25% would have increased the total expenditure $5,000,000. As $23,000,000 was the limit of bonded indebtedness of the city, this increase would have blocked the enterprise. The Chamber of Commerce and other public-spirited citizens went to Sacramento and succeeded in killing the objectionable measure.

These are some of the difficulties that Mr. Mulholland and his associates met with, altogether unconnected with the physical and engineering obstacles, which were sufficient in themselves to have daunted less stout hearts.

Laying Out the Work

The planning and the preparations for the building of the aqueduct were difficult and stupendous in their scope. Transportation facilities between Mojave and Owens lake were confined to a rickety stage coach. Water holes on the desert were 15 miles or 20 miles apart, and water would have to be piped down from distant mountains. There was no timber for construction or fuel and of course no coal. Upon making up his estimates, Mr. Mulholland found that the aqueduct would require a million tons of material and that 6,000 men would be necessary to complete the work within the time he had fixed. A railroad 120 miles long, from Mojave to Owens lake, would be required to take the place of the rickety stage coach. Hundreds of miles of roads and trails must be built to make all parts of the work accessible. Cheap electric power must be installed for power shovels, dredges and air compressors. The housing and feeding of the thousands of laborers and miners must be provided, with sanitary conditions. Telephone lines had to be installed for full length of the work for communication with general headquarters at Los Angeles, and all parts of the line.

A contract for transportation was made with the Southern Pacific R. R. Co., which provided that that corporation should build a standard-gauge railroad from Mojave, 144 miles north to Owenyo, north of Owens lake, where it would connect with the California and Nevada narrow-gauge road. This line was rapidly built in 1907.

There were 315 miles of roads and trails built, and 150 miles of copper wire telephone line were installed, connecting the main office in Los Angeles with all parts of the work. Three hydroelectric plants were established with a high voltage transmission line to convey the electric energy to the excavating and other machinery along the Aqueduct and for lighting the many camps. Four water systems, with three reservoirs and 400,000′ of pipe line, were made and used to convey pure water to the camps and places where needed.

The Aqueduct Cement Plant

The proper quality of lime and clay to produce a good Portland cement was discovered at Tehachapi, and the city constructed a cement manufactory, at an expense of $850,000. More than 1,000,000 bbls. of cement were made, and used in the work, additional to that which was purchased from other cement manufactories. This resulted in a large saving in freight and obviated delays from lack of cement in prosecuting the work.

Careful Preliminary Work

Two years were exhausted in finding the best and most feasible route, which was often changed by Mr. Mulholland and Mr. Lippincott for economic or other good reasons. Fourteen months were required for the enormous preparatory work which has been referred to. So that, with the exception of some work at the Elizabeth Tunnel and at the Intake, the actual construction work on the Aqueduct began in October, 1908. The wisdom of thorough preparation even at the cost of considerable time was fully vindicated by the rapidity and certainty with which it proceeded from that time.

The Aqueduct

The Intake, which is constructed of concrete in the most solid and substantial manner, is situated 35 miles above the mouth of the Owens river, to insure against the possibility of alkali solutions. Its elevation above sea level is 3,812′. The dimensions of the Aqueduct vary greatly on different parts of the work, depending upon the physical nature of the country through which the water is passing. The first 22 miles is a canal, 62′ wide at the water surface, 38′ wide at the bottom and 10′ deep, uncemented, and at an elevation slightly higher than the river. This canal was excavated by three electric dredges.

At the Alabama foot-hills the Aqueduct is conducted along the mountainside, passing Owens lake on its western side and about 200′ above the surface. This part of the Aqueduct is concrete lined, 30′ wide, 12′ deep and 38 miles long to the Haiwee reservoir, the first of the five great storing basins. This upper portion of the Aqueduct, to Haiwee reservoir, is the only portion uncovered. All the remaining conduit is covered with reinforced concrete slabs 6″ in thickness. The conduit is lined with concrete from 8″ to 12″ in thickness.

South of Haiwee reservoir the size and shape of the Aqueduct vary considerably, and were determined by the topography of the country and character of the soil. The average size is 12′ wide and 10′ deep.

The Tunnels

The enormous amount of work on the tunnels, their great length, and the rapidity with which they were driven, are one of the most notable features of the Aqueduct. All told, there are 150 tunnels on the line, of varying length, from 100′ to the great Elizabeth Tunnel, 26,870′, or over five miles, long. All world records for tunnel construction were broken in this tunnel. The estimate of the Bd. of Consulting Engrs. was that one year's time would be required for preparation, four years for actual construction, and $1,913,000 as the cost. Work was begun simultaneously at both ends of the tunnel Oct. 5. 1907, and 250 men were employed night and day in boring the mountain. An average rate of 11″ per hour was made throughout, and the tunnel was completed Feb. 28, 1911, in a period of 3 years 7.3 months, and at a cost of $500,000 less than the estimate. It is the second longest water tunnel in the United States.

The total length of tunnels on the Aqueduct is 52.035 miles, of which 43,129 miles are on the main aqueduct, and 8.906 miles on the power system.

The Reservoir System

There are five reservoirs on the line of the Aqueduct, the largest being the Haiwee reservoir, which is intended for storage, clarification and regulating purposes. The capacity of the canal and cement-lined conduit leading to this reservoir is 500,000,000 gals. per day—about twice the capacity of the Aqueduct below that point—and made so large for the purpose of carrying the excess flow in the melting season, and accumulating a large reserve. The Haiwee reservoir, which occupies a former channel of the Owens river, is now a large lake seven miles long, with an area of 15 sq. miles, and a storage capacity so large that in case of emergency it would amply supply the city of Los Angeles for three years.

The Fairmont reservoir is 127 miles south of the Haiwee reservoir. Its purpose is for regulation rather than storage—its capacity being limited to 10 days' flow of the Aqueduct. Its purpose is to regulate the flow into the Elizabeth Tunnel, through which the water will flow to the seaward side of the Coast range. The reservoir covers a surface of 165 acres.

The Dry Canyon reservoir is a small reservoir, a few miles from the terminus of the Aqueduct.

Two reservoirs are in course of construction in San Fernando valley, at an elevation of from 1,100′ to 1,200′ above the city, and are for the purpose of impounding the water just below the outlet of the Aqueduct, and to regulate the distribution. These two reservoirs mark the end of the Los Angeles Aqueduct proper. At the recent bond election, held Apr. 15, 1913, the city voted $1,500,000 additional bonds, to construct a trunk line from these reservoirs, 28 miles to the city limits, where it will connect with the city water mains.

Crossing the Valleys

While the boring of the mountains by tunnels is sufficiently difficult, the task of carrying a great flow of water across the valleys is little less so. In many instances it is much more difficult. In some places this crossing of valleys was done by building the great conduit of solid concrete, supported by columns and abutments of the same material. More frequently, however, the valleys are crossed by means of enormous steel siphons, with a diameter of from 7′ 6″ to 11′, built to stand a pressure up to 350 lbs. per sq. in. There are on the line 23 of these siphons, crossing as many canyons, with an aggregate length of 12.06 miles. The only rock siphon on the line—that at Sand Canyon—on trial failed to stand the pressure, and is now being rebuilt of steel.

Aqueduct Work Classified

A classification of the work as it has been carried out, extending from the Inlet Gates to the Outlet on the rim of the San Fernando Valley, includes the following construction:

Classification		Length in Miles
Open unlined canal		23.802
Open lined canal		37.168
Covered conduit		97.641
Tunnels	42.903	
Power tunnels	8.906	51.809
Siphons, steel and concrete		12.052
Flumes		0.165
Reservoirs		7.870
Haiwee Reservoir tunnel outlet		0.226
Haiwee Bypass		2.000
Power siphons		0.239
Power penstocks and tailrace		0.700
Total length of Aqueduct (to San Fernando)		233.672

Generation of Electrical Energy

Aside from the sales of water for domestic use and the surplus, which for many years will be large, for irrigation purposes, it is anticipated that the most prolific source of revenue, with which to meet the principal and interest on the bonds which have been and will be issued for the construction of the Los Angeles Aqueduct, will be the sale of electric energy produced by the waters of the Aqueduct, in their descent from an altitude of 3,812′ at the Intake, to its outlet in the San Fernando valley 1,461′ above sea level. The construction of the power plant is an independent operation from that of the Aqueduct.

In 1906 E. F. Scattergood, the Aqueduct's ch. elect. engr., made an estimate of the cost of development of 37,000 h. p., delivered at the city boundary, at $4,490,000. Apr. 10, 1910, Los Angeles voted bonds to the extent of $3,500,000 for the purpose of partially developing the electrical power of the aqueduct, which eminent electrical engineers estimate at 120,000 h. p. peak load. It is not the intention to develop the full amount at this time, but eventually, as the demand for power increases, as it inevitably must, plants sufficiently extensive to develop all the power possible will undoubtedly be put in.

The first electric power plant is 47 miles from Los Angeles, at Clear Water Canyon. The water plunges from the mouth of Elizabeth tunnel 935′ down the precipitous side of the canyon upon the power-producing water-wheels, whence the power will be transmitted to the city over high tension lines. The plant being erected will produce 37,500 h. p., and it can be increased at this point by additional construction to a limit of 75,000 h. p. After leaving the wheels of the first power plant, the water will be carried seven miles along the rim of San Francisquito Canyon and dropped down 512′ upon the wheels of a second power plant to be built whenever the demand for additional electrical energy shall require it. A third power plant to develop a maximum of 10,000 h. p. can be built between the Aqueduct Outlet and the Upper San Fernando Reservoir. And still another power plant, capable of producing 3,400 h. p., can be placed on the main trunk line to the city at Franklin Canyon, in the Santa Monica mountains.

Finishing Up

There is considerable work still to be done in the way of finishing up the odds and ends of the great aqueduct work, such as building distributing systems for the surplus water for irrigation purposes, and for transmission and distributing systems for electrical energy. There is a vigorous demand for both water and power, however, and the satisfactory completion of these distributing systems, large in themselves but insignificant in comparison with the work of building the great Los Angeles Aqueduct, will be a matter of but a short time, and after the people of Los Angeles have fully decided how they desire the work done it will be a trifling chore for the big Chf. Engr., William Mulholland, and his able assistant, J. B. Lippincott, after their big work.

An Ingenious Dam in French Indo-China

The accompanying sketches and photographs show a dam recently designed and built by P. H. Barriere for the Societe des Charbonnages du Tonkin, Hongay, French Indo-China. The following notes in *Concrete & Constructional Engineering*, London, describe the dam briefly.

As shown in the drawing, it consists of a continuous reinforced concrete slab making an angle of 55° with the ground level, its thickness being 1′ at the base and 5″ at the top. It rests on a series of buttresses 7′ apart. These are trianglar reinforced concrete frames, the different parts of which are bound together by a vertical slab 3½″ at the bottom and 2″ at the top. The principal strut carries the resultant pressure of the water to the ground, where the strut is embedded in the rock, as is also the base of the inclined slab.

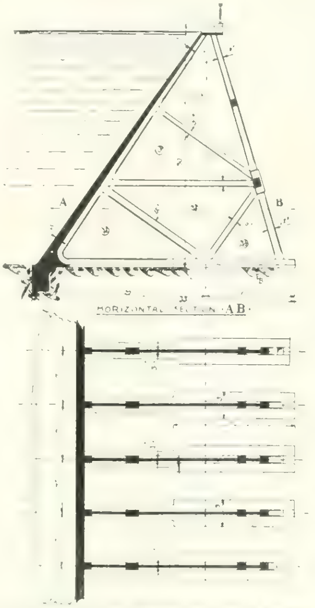


Fig. 1—Plan and Section of Dam in French Indo-China

The outside face of the inclined slab was surfaced with cement mortar 1½″ thick, and has been found quite waterproof.

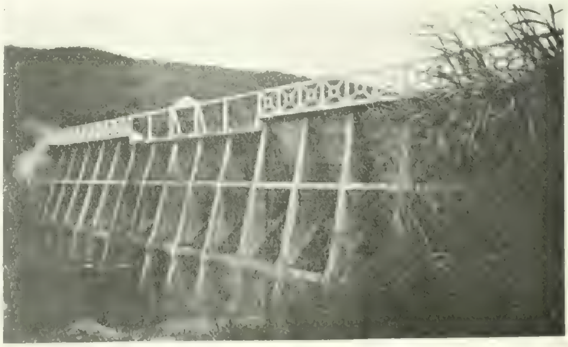
The inclined slab has been designed with round steel bars as top and bottom reinforcement. The bending moments used were $\frac{w\ l^2}{12}$ and $\frac{w\ l^2}{24}$ and were considered sufficiently safe. The measured deflections of the slab were practically *nil.* The native labor available had no previous experience in reinforced concrete work.

The resevoir formed by the dam contains a total quantity of about 8,000,000 gals. of water. The greatest height of the dam at the center is 30′ and the total length 160′.

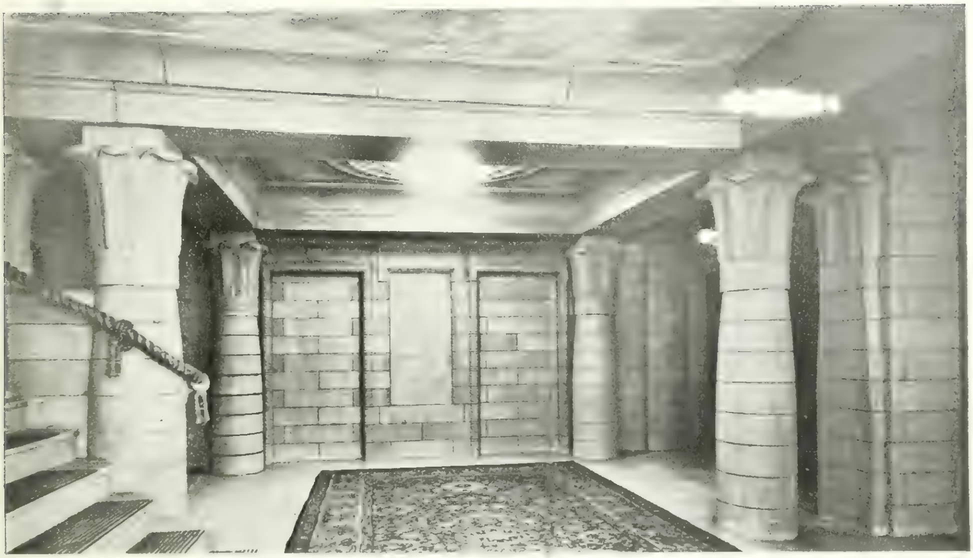
Reclamation Work in Montana

Sealed proposals will be received at the office of the U. S. Reclamation Service, Great Falls, Mont., until Dec. 18, for the construction of structures of the Pishkun Reservoir Canal and Sun River Canal, involving about 82,000 cu. yds. of excavation, 14,000 cu. yds. of concrete, placing 664,000 lbs. of reinforcing steel, erecting about 40,000 lbs. of structural steel, placing in wooden structures about 66,000 feet b. m. of lumber, and laying about 24,000 lin. ft. of drain pipe. The work is situated near the line of the Sun River Branch of the Great Northern Ry. The office of the U. S. Reclamation Service, at Washington, D. C., at Great Falls, Mont., or at Fort Shaw, Mont., will be glad to furnish further information.

A large concrete dam will be built across the Connoquenessing creek by the Pittsburgh, Harmony, Butler & New Castle Ry. Co., operating one of the large interurban traction lines running out of Pittsburgh. Chester & Fleming, Pittsburgh, are the engineers.



[illegible] The Down Stream Face of the Dam



Basement Elevator Foyer of Hollenden Hotel, Cleveland, Using Concrete Stone.

An Unusual Work in Concrete Stone

BY GEORGE F. HAMMOND*

Egyptian architecture is exceedingly heavy, and the good examples of it to be found in modern work are few and far between. While I have always been very much interested in Egyptian architecture, I have never, with a few exceptions, found an opportunity where I could reasonably expect a client to adopt it, for either exterior or interior work. The idea which proposed itself to me in connection with the elevator foyers in the recently rebuilt central section of the Hollenden hotel, Cleveland, was to have each one different, and as there were thirteen floors, it was my idea that it might be interesting to show different styles of architectural design adopted for the finish or trim in each story, which would have produced, naturally, the Assyrian or Egyptian orders in the lower stories, continuing with Greek, Roman, Renaissance and Gothic, all the way up.

I had in mind the thought that when an elevator stopped at a floor, no passengers in a car would be liable to step off at the wrong floor if each floor had a distinct individuality of its own.

I also had an idea, possibly not very practical, that a foreigner might be attracted by some suggestion of his home country, so that a German would recognize Rothenburg; a Swiss, the Alps with châlet treatment; an Italian, views of Florence, Pisa or Capri, and of course mural decorations would form the greater part of the thought I had in mind, although of course each floor representing a country would be treated in the style best known as typical of that country.

This idea was to be confined exclusively to the foyers of each floor, directly in front of the passenger elevators. It, however, was not adopted, and like many other architects' "castles in Spain," did not become a reality.

After the matter had been discussed by myself and the owners, the idea was abandoned, with the exception of two or three stories, and the basement being the lowest story, I decided to use the Egyptian treatment for this elevator foyer.

Being thoroughly familiar with Egypt, from Alexandria to Philae, and having some 1,500 or 2,000 negatives which I made myself in Egypt a few years ago, in addition to a print from every professional negative by all the professional photographers I could hear of in Egypt, I undertook to produce what is shown in the accompanying illustration, and to produce it correctly, and I do not feel that I am saying too much in stating that the execution of the work in concrete by The George Rackle & Sons Co., Cleveland, has been entirely satisfactory, and that the work has been faithful and an accurate representation of my detailed drawings. As for the drawings, no credit can be attached to me, as they are merely the copies of Egyptian work, the work we designed having been created thousands of years ago. I merely adapted it.

On account of the prevailing red granite and copper bronze color, I decided to use the red lotus blossoms for the decoration of the elevator door panels. The columns, in fact all of the artificial stone work, are made to match as nearly as possible, the red Syrene granite from which most of the obelisks were cut.

The capitals are made from types which may be found in Egypt at Philae, and are of the palm type, and to my mind are more graceful, although possibly not quite so typical of Egyptian work as it is known, as are the lotus buds of lotus bell capitals or Hathor-headed capitals.

Cleveland is a soft coal city, and aside from the fact that the space is somewhat restricted, I wished to have the work so designed that it could be kept clean with the least amount of labor.

At either end of the room are two panels between the two Egyptian doorways. These panels, to anyone not familiar with Egyptian work, will appear flat and insignificant, but as is well known by sculptors or by persons familiar with cameo or intaglio work, the flatter the sculpture, the more difficult it is to produce rounded surfaces. These two panels represent Isis and Osiris, and the manner in which the sculptor, Mr. Jirouch, of The Fisher & Jirouch Co., modeled the work is most praiseworthy.

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*Architect, Cleveland.

The concrete stone made by The Geo. Rackle & Sons Co. in reproduction of red Syrene granite was given its color with a facing mixture in which red crushed granite and red color were used, so proportioned and subsequently sprayed and scrubbed as to produce the effect desired.

Magnesium Chloride in Artificial Wood Floors

Basic magnesium chloride, sometimes known as magnesium oxy-chloride, is mixed with wood meal, sawdust or shavings to form practically all the artificial wood flooring. Cork waste is sometimes substituted for the wood meal. The compound has been much more popular in Germany than in the U. S., probably because of greater practice and skill in putting it down. However, there have been heavy importations of the raw materials to this country, particularly to Los Angeles dealers. These raw materials are burnt magnesite, or magnesium oxide, from Greece, and magnesium chloride from the Stassfurt mines, Germany. The two are ground and mixed dry with sawdust. The addition of water causes the formation of magnesium oxychloride, a hard substance suitable for flooring and when mixed with wood fibre elastic to a slight degree. This with the fact that it is a poor conductor of heat and will only char in a fire makes it excellent for flooring.

The objections to its use come from lack of skill in laying it. Unless the materials are mixed in the right proportion trouble occurs. Too much magnesium chloride makes it take up moisture although oil is sometimes added to prevent this. Too much magnesium oxide causes expansion and cracking due to the absorption of CO_2. Evidently chemical analysis and calculation could prevent these troubles.

A manufacturer claims that it is cheaper than pine flooring or tiling and that it can be poured directly over worn-out floors if they are made firm. It should be cleaned with cold water but rarely should warm water and soap be applied. In fact waxing and oiling is the best practice.

In Germany the cost per sq. yd. of 1-in. flooring of this character is about $1.50. The magnesium chloride is worth, in 50-ton lots, in casks of 880 lbs., f. o. b. Hamburg, $11.50 per ton fused. In smaller lots, $12. Greek calcined and powered magnesite, in barrels of 396 lbs. to 440 lbs. is worth $33.32 to $35.70 per 2,200 lbs., f. o. b. Rotterdam. Raw magnesite, in casks, is worth $30.94 per 2,200 lbs., f. o. b. Hamburg. These figures with a list of the U. S. import duties will furnish the builder something to figure on.

Moving a Reinforced Concrete Building

Mar. 29, 1912, there was finished a five-story and basement reinforced concrete hotel for G. G. Burnett Estate Co. in San Francisco, costing $65,000. The building was from plans of C. H. Skidmore, architect, and erected by H. C. Warwick. The weight of the building is 1,560 tons; it contains 71,280 lbs. reinforcing steel bars and metal sash throughout.

Three days after completion and but a few hours before it was about to be leased, the owners were served with notice of a condemnation suit of the land and building as a part of the city's Civic Center.

The hotel was on a lot 50′ x 100′ on the north line of the principal business street. After getting title to the property the supervisors were unable to find a purchaser.

Tests and examinations of the concrete and reinforcing steel proved that the building was so firmly bound and tied together that for a long while it was believed that nothing but dynamite could dislodge it.

Finally, after more than a year, the hotel was given without charge to Robert Bruce, including a bonus of $1,750 for removal. The walls were cut off at the street level, raised up on blocks and rollers, and the entire structure was taken to a new location, ¼ mile distant.

The sign at the top of the illustration is correct in stating this to be the largest reinforced concrete building ever moved. In the course of the trip it was turned twice, crossed two streets with four electric car rails and over the City Hall foundations. Powerful donkey engines supplied the pulling power.

The view shows an elevation of 10′ to enable crossing the City Hall foundations, portions of which are that height above the street.

Completion of The Gunnison Tunnel

The Secretary of the Interior has authorized the Reclamation Service to complete the concrete lining of Gunnison tunnel, Uncompahgre Valley irrigation project, Colo. This tunnel, which passes under Vernal Mesa 2,000′ high and carries the waters of the Gunnison river into Uncompahgre Valley, is approximately six miles long, and the largest irrigation tunnel in the world. Its cross-section is 10′ 6″ x 11′ 6″.

When constructed all portions of the tunnel which required timbering, aggregating about one-half the total length, were lined with concrete, and a concrete floor was laid throughout practically the entire length. The walls and arch through the solid rock section were left unlined until such time as this work might be required to lessen the frictional resistance and increase the carrying capacity of the tunnel.

The approaching completion of the tunnel will involve the placing of 15,600 lin. ft. of side wall and arch lining, and 156 ft. of complete lining, including floor. The work will be carried on by government forces, and it is estimated will cost $212,440.

The big cement show will be on in Chicago, February 12-21.

Moving a Reinforced Concrete Building in San Francisco

Design Features of San Diego Y. M. C. A. Building

BY E. P. CYKLER*

THE DESIGN PROBLEMS of running track construction are briefly outlined in the following notes. Reinforced concrete is used throughout as the structural material with terra cotta floor cores and curtain walls. Of especial interest is the use of steel tie rods for the roof arches.

The San Diego Y. M. C. A. building, recently completed, furnishes some very interesting structural features to meet unusual conditions. In order to obtain an open gymnasium floor, the running track, which as usual in such construction, is a balcony running around the walls of the main room, was supported on cantilever girders, as shown in section through the gymnasium (Fig. 2). The bottom of the running track was furred with metal lath and plastered, to give a flat surface around the bottom side of the entire track. The surface of the track was made of ⅞-in. flooring and covered with canvas. The size of the gymnasium building proper is approximately 100′ x 49′.

Fig. 4 is a view of the running track, illustrating the circular girder at the ends of the cantilevers shown in detail in Fig. 3, also the arches in the roof construction. Note the pleasing effect given by this framing and how well the gymnasium floor is lighted from the skylights above. No terra cotta has been set into the walls at the time this plate was taken. Under the gymnasium floor are the swimming pool and locker rooms and a spectators' gallery for watching swimming contests.

The running track girders and cantilevers were figured for a live load of 75 lbs. per sq. ft., in addition to the dead load which amounted to 60 lbs. per sq. ft. This live load was figured to take care of spectators in time of games, etc., on the gymnasium floor, when the running track would be converted into a spectators' gallery.

These cantilevers (K. 1 of Fig. 3 and top of Fig. 1) were spaced 16′ o. c. with a minimum length at the center line of the track of 5′ 10″, over all from the face of the column. The super-elevations on this track at the various points of its circumference were given by the Narragansett Machine Co. The concrete framing was then designed to conform to their surface layout, and to carry the proper loads. To give an idea of the slope of the track, Fig. 2, shows the surface at the straight portion of the track, while Fig. 5 shows the incline of the surface at the circular portion.

The beams H. 1 and H. 2 were notched to take the 2-in. wood joints, cut to fit the curvature of the track surface and spaced 12″ o. c., as shown in detail.

An iron pipe railing was bolted to the 2-in. x 6-in. wood strip along the outer edge of the track.

These cantilevers, K. 1, K. 5 and K. 6, etc., occurred at columns only except along one end where they ran through a large wall girder (see Fig. 6).

The columns were made 12″ x 18″, and reinforced with six ¾ in. sq. bars, three in each face. This was found to be sufficient to carry both the dead and the live load stresses from the arches and walls, together with the stresses induced by the cantilevers.

The columns were figured according

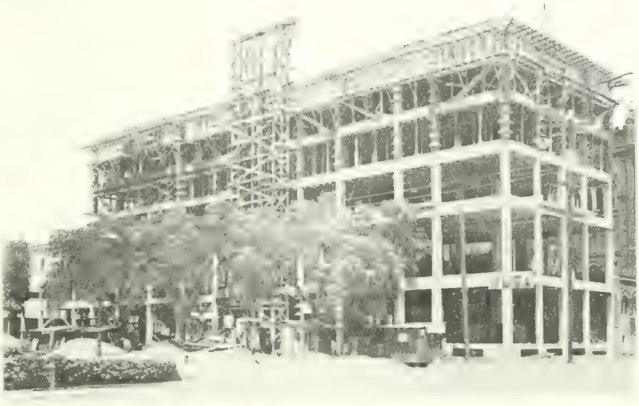

Fig. 1—The Y. M. C. A. Building at San [illegible], with the Fifth Floor and Roof Forms in Place

The gymnasium floor is the [illegible]. The running track is at the second story elevation.

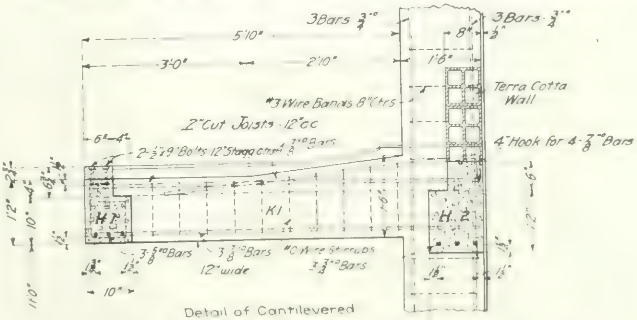

Fig. 3—Detail of Cantilever for [illegible] of Running Track

This detail beam K 1 shown in plan, Fig. [illegible]

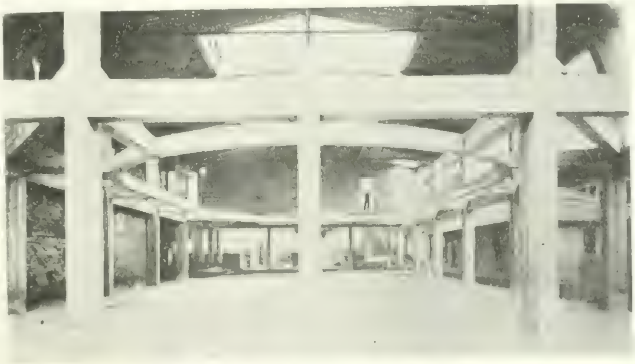

Fig. 4—Interior View showing the Running Track and the [illegible]

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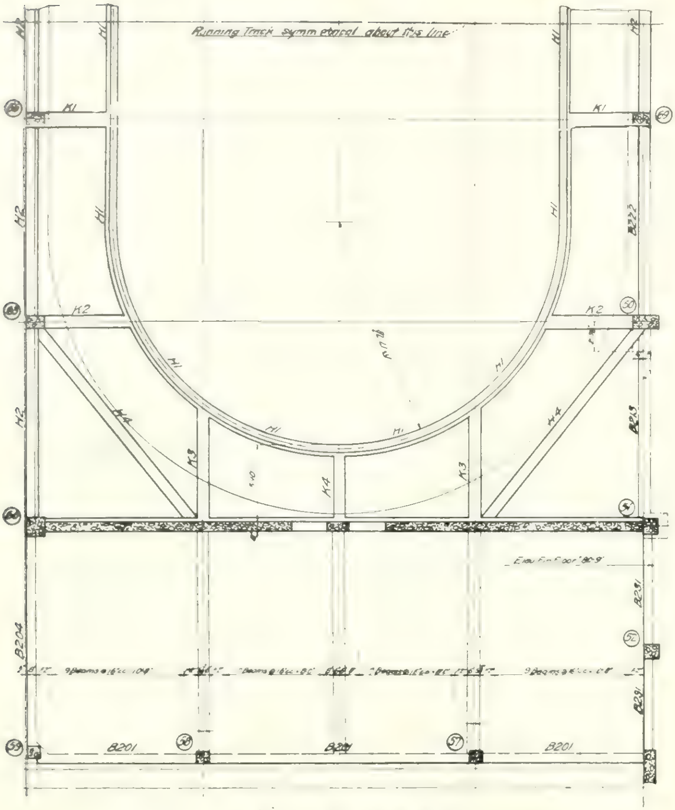
*Asst. Engr. with H. L. [illegible], San [illegible]



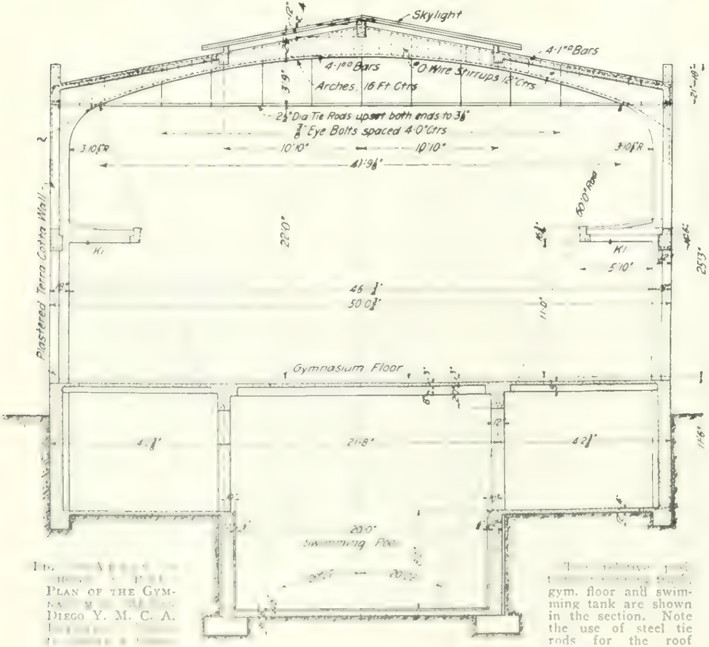
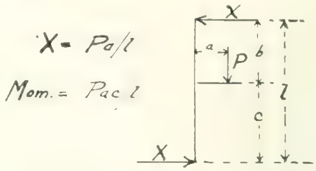


FIG. [illegible] PLAN OF THE GYMNASIUM [illegible] DIEGO Y. M. C. A. [illegible] SECTION

[illegible] gym. floor and swimming tank are shown in the section. Note the use of steel tie rods for the roof arches.

to the following formula for eccentric loadings.



The column was then reinforced to take care of this moment.

The cantilevers were reinforced with three ⅞-in. bars in "U" shape and four more were placed straight in the top with a hook into the column (see Fig. 3). These four bars were placed in straight, as it was not considered that they would work properly if bent to conform to the upper outline of the cantilever, for the reason that the heavy stress would tend to straighten them out before they would come into action.

The bonding of these ¾-in. bars into the column did not exceed 80 lbs. per sq. in. of surface when the track was fully loaded.

Beam H. 1 was figured to carry ½ of the track load, and H. 2 in addition to carrying the track, carried the hollow terra cotta wall, which was used in this building for curtain walls. George W. Kelham, San Francisco, is the architect, and H. I. Brunnier, San Francisco, the consulting structural engineer.

A recent paper by Dr. Framm, on the comparative strength of Portland cement hardening in water and hardening in air and water, which appeared recently in a German chemical journal has been summarized in a recent issue of *Chemical Abstracts* as follows:

Five high- and five low-strength cements were tested in tension and compression up to 2 yrs. in 1:3 and 1:6 mortar mixes. Plotting the results showed for hardening in water little variation in the curves, some tests being continuously high and others low. When the mortar was hardened in air and water the maximum strength was developed at about the 21st day. Up to this time the increasing strength was rapid, followed by a slower increase up to a period of 6 mos. This is, in turn, followed by a retrogression in strength. When mortar specimens are hardened in air and water the strength is about 50% above that of water hardening for 1:3 mix at 28 das. and about 80% higher for the 1:6 mix. In 28 das. and up to 3 mos. time there is a retrogression followed by a rise in these mortars, while for mortars hardened in water the greatest strength is developed at 6 mos.

The addition of hydrated lime in some of these tests developed somewhat additional strength, especially in the 1:6 mix, and was more marked in the specimens hardened in water and air, than in those stored in water. The addition of trass to some of the specimens gave a definite increase of strength in the specimens stored in water only.

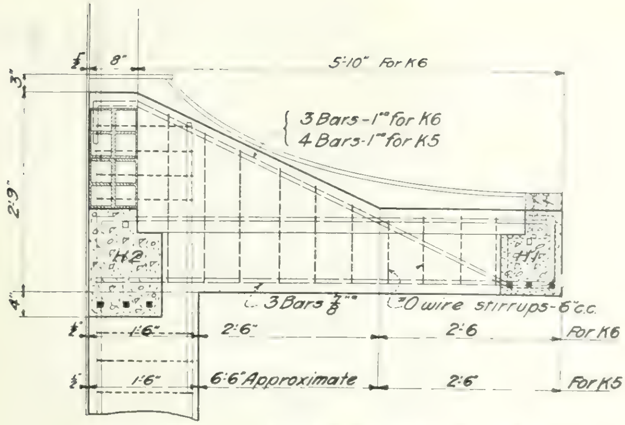


Fig. 5—Detail of Cantilever Beams Supporting the Track at the Curves

These are details of beams K.5 and K.6

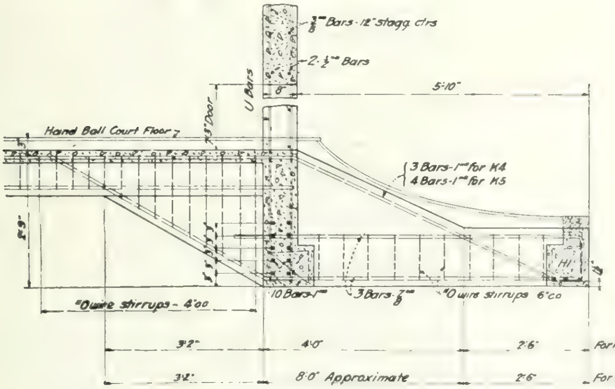


Fig. 6—Detail of Cantilevers at End of Track Through Into the Hand Ball Court

Beam K.4 is shown in detail here

Daily Conferences of Contractors on Rush Work.

The Statler Hotel, Cleveland, which was recently completed on a rush order by James L. Stuart, contrg. engr., Pittsburgh, presented many interesting features of construction administration. One of the many practices which helped very much to expedite the work and "iron out" all difficulties was a daily meeting of all the sub-contractors on the work, together with architects' representatives and others interested in the building. At these daily meetings each trade was taken up separately with the principal representative of that particular trade and the representatives of all the other trades present. He was asked regarding the progress of his work and was told to state whether or not he was being retarded by any of the other trades If it was found that he was being hampered he was made to state explicitly and in detail to what extent and how.

The advantage of having all of the sub-contractors together at one time can readily be seen, as it eliminated innumerable quarrels among the foremen of the different trades and many misunderstandings which invariably arise due to the fact that the workmen and foremen are not always capable of expressing their troubles in an intelligent manner and, when they are busy, many times do not take the trouble to express themselves at all.

It was rather hard to get them continually to attend these daily meetings, as they were held in the evening after they were supposed to be through with their work. The engineer in charge of the work tried to make the meetings as pleasant and as short as possible and never permitted ill-feeling to persist among the several trades, arising from the discussions at the meetings. A typewritten report of each meeting was posted up on the general bulletin board so that each of the sub-contractors would have access to it the following day.

Whitewash and Efficiency in a Products Plant

In this age of great undertakings it is well not to lose sight of the little things that so often make them possible, says *Youth's Companion.*

A newspaper man who was writing a series of articles about the men who are at the head of large and successful businesses called upon the general manager of a factory where concrete block are made. This man had brought the business from a precarious and feeble infancy to a condition of great financial strength. The interviewer wanted to hear about the first practical thing the man had done to improve the working conditions, and increase the efficiency of the plant.

"The first thing I did was to buy lime enough to make 12 barrels of whitewash," said the manager; and he smiled at the recollection.

"Good," exclaimed the reporter, quick to recognize the kind of story he wanted.

"The first thing I learned after coming here was that the company had difficulty in keeping good laborers. The hours and wages were right, and nobody could understand why so many left, or why the ones who remained were surly and discontented. I went out to take a look round the factory, and I found the trouble in about five minutes. The place was too dark and dirty!

"Making concrete block is not a clean job, at best, and it is impossible to keep a factory free from the flying dust, but there was no reason why the place should be so dark. We could not put in any more windows, so I decided to light the great, dingy, barn-like structure from the inside. In the center of the room was a pit about 5 ft. deep, in which the base of the engine rested. That pit made me shudder; it reminded me of one of Poe's tales. It was so dark that every time a man went down to oil the machinery he had to carry a torch, and grope his way down a ladder.

"That very day I ordered the whitewash; it was the cheapest artificial light I could provide. I gave every available man a long-handled brush and a ladder. They went to work with enthusiasm, and in a short time we could hardly believe we were in the same building. The men even whitewashed the pit, and after that it was never necessary to carry a torch. The surly, discontented laborers turned into well-behaved, decent workmen, and we had no more labor problems to solve.

"Those foreigners had never studied psychology, and they had no idea that after that they did more work in a day, did it better, and with less physical exertion than before. After all, psychology is too big a name for it; it is common sense. Whitewash is cheaper than strikes. Since then I have continued to [illegible] dirty situations in business life, and it never fails!"

Effect of Salts upon Concrete Cured at low Temperatures

In a recent issue of the *Wisconsin Engineer,* there is a report by H. E. Pulver on a series of tests conducted by S. E. Johnson and Mr. Pulver to determine the effect of sodium chloride (NaCl) and calcium chloride ($CaCl_2$), separately and together, upon a 1:2:4 concrete cured at low and normal temperatures. By normal temperatures are meant ordinary room temperatures, from 60° F., to 75° F., while the low temperatures indicate those below freezing.

In performing the tests common salt (NaCl) and calcium chloride ($CaCl_2$) were used, dissolved in the mixing water, the percentage of the salts being varied over what seemed to be a practicable range. For the salts alone the percentages of NaCl in the mixing water were 6, 9, 12 and 15 by weight while those of the $CaCl_2$ were 2, 4, 6, 8 and 10. When the salts were mixed the range was from 6% to 15% for the NaCl and from 2% to 8% for the $CaCl_2$.

The Specimens Used

The specimens were 4-in. cubes. Those cured at low temperatures were broken at ages of 14 das. and 60 das., while those cured at normal temperatures were broken at ages of 14 das., 60 das. and 360 das. Four specimens were broken at each age for each batch of concrete. For the specimens cured at low temperatures, an effort was made to get the curing conditions as near as possible like the most rigorous ordinarily found in commercial work.

Materials

The sand used was a good quality of bank sand from Janesville, Wis., weighing 108 lbs. per cu. ft. Soft crushed limestone from quarries near Madison, Wis., passing a 1¼-in.-mesh, and weighing 90 lbs. per cu. ft., was used.

A mixture of water and Na Cl was made, using 25% by weight of the salt. A 20% solution of $CaCl_2$ was used, each solution being stored.

Materials at room temperatures were used in making specimens which were to be cured under normal conditions. In making specimens to be cured at low temperatures, the cement was at room temperature, the aggregate was brought in from the outside where the temperature was below freezing and the water was taken directly from the city mains. The temperature of this water was usually about 55° F., and that of the sand and stone, brought in from the outside, about 20° F. For a record of the temperatures observed, when the different batches were made, see Tables I and II.

The specimens cured at normal temperatures were allowed to remain in the air for 24 hrs. after making, next placed in running water for 13 das., and then stored in air until broken. The temperature varied from 60° F. to 70° F. during the curing period. The cubes cured at low temperatures were, immediately after making, stored in cold air, either outdoors or in a refrigerator, where the temperature was below freezing throughout the curing, excepting two das. when the temperature rose to a maximum of 35° F. All low-temperature specimens were stored in the laboratory, at normal room temperature, for one day before breaking.

All of the testing was done in a 100,000-lb. capacity Riehle[1] "Universal" testing machine. The cubes rested on a spherical bearing block, and care was taken that they were centrally placed in the block. Three or four thicknesses of blotting paper were used, both above and below, in bedding the cubes. The results of the tests on the cubes are given in Tables I and II.

Conclusions

The curves show, that as the percentage of NaCl is increased, there is a nearly straight line decrease in the

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[1] Riehle Bros. Testing Mach. Co., Philadelphia

TABLE I.—TESTS OF 1:2:4 CONCRETE CURED AT NORMAL TEMPERATURES

VARYING PERCENTAGES OF SALT IN MIXING WATER

Date Made 1912	Temperature When Mixed Room	Temperature When Mixed Batch	Salt Percent $CaCl_2$	Salt Percent NaCl	Unit Compressive Stress lbs. per sq. in. 14 Das.	Unit Compressive Stress lbs. per sq. in. 60 Das.	Unit Compressive Stress lbs. per sq. in. 360 Das.
Mar. 9	63	52	0	0	1910	3010	3580
*Feb. [illegible]	63	58	0	0	1240	1330	
Mar. 9	63	52	0	6	1684	2620	2895
Feb. 10	[illegible]	65	0	[illegible]	1525	2385	3055
Feb. 12	68	68	0	12	1270	2060	2485
Feb. [illegible]	63	[illegible]	0	15	1335	2220	2740
Feb. 13	69	59	2	[illegible]	1920	3220	3740
Feb. 14	67	61	4	0	2105	3510	3880
Feb. 15	69	60	6	0	1725	3280	3670
Feb. 15	69	61	8	0	1510	3070	3155
Feb. 16	68	61	10	0	1655	3025	3330
Feb. 16	70	59	2	6	1600	2650	3150
Feb. 17	71	63	2	9	1695	2590	3100
Feb. 17	71	64	2	12	1420	2440	2805
Feb. 20	63	60	2	15	1320	2350	2725
Feb. 22	66	56	4	6	1585	2550	2960
Feb 22	68	58	4	9	1550	2390	2965
Mar. 2	63	58	4	12	1710	2935	3680
Mar. 4	65	55	4	15	1245	1880	2410
Feb. 26	68	60	6	6	1310	2475	2575
Mar. 1	65	54	6	9	1305	2370	3025
Mar. 6	62	54	6	12	1345	2420	
Mar. 6	62	52	6	15	1380	2415	
Feb. 26	68	60	8	6	1120	2075	2490
Mar. 8	62	58	8	9	1135	2085	2445
Mar. 8	62	60	8	12	1110	1995	2525
Mar. 7	63	59	8	15	1550	2605	2940

All temperatures are given in degrees of Fahrenheit.
*Cured in inside air and not placed in running water.

TABLE II.—TESTS OF 1:2:4 CONCRETE CURED AT LOW TEMPERATURES

VARYING PERCENTAGE OF SALT IN MIXING WATER

Date Made 1912	Temperature When Mixed Room	Temperature When Mixed Outdoors	Batch	Salt Percent $CaCl_2$	Salt Percent NaCl	Unit Compressive Stress lbs. per sq. in. 14 Das.	Unit Compressive Stress lbs. per sq. in. 60 Das.
Jan. 20	64	13	52	0	0	213	427
Jan. 30	61	13	51	0	6	482	685
Jan. 30	61	13	51	0	9	680	942
Jan. 30	61	13	51	0	12	813	1192
Jan. 20	64	13	42	[illegible]	15	614	1060
Feb. 5	69	17	41	2	0	420	466
Feb. [illegible]	69	17	44	4	0	444	564
*Feb. 5	69	18	[illegible]	6	0	349	367
*Feb. 8	72	1	16	8	0	286	334
*Feb. 8	67	1	46	10	0	234	348
Feb. 12	68	15	[illegible]	2	6	817	992
Feb. 12	68	15	[illegible]	2	9	848	1185
Feb. 9	66	7	41	2	12	690	1045
Feb. 9	68	7	38	2	15	583	807
Feb. 18	58	21	[illegible]	4	6	785	914
Feb. 18	58	[illegible]	51	4	9	755	926
Feb. 20	63	[illegible]	[illegible]	4	12	766	1215
Feb. 20	63	15	[illegible]	4	15	713	1200
Feb. 21	54	[illegible]	43	6	6	680	988
Feb. 21	53	20	38	6	9	480	850
Feb. 27	63	21	52	6	12	505	615
Feb. 27	63	21	[illegible]	6	15	527	863
†Feb. 27	63	21	51	8	6	390	590
Feb. [illegible]	67	[illegible]	[illegible]	8	9	487	654
Feb. 28	65	[illegible]	52	8	12	402	589
†Feb. 29	65	14	44	8	15	[illegible]	658

All temperatures are given in degrees of Fahrenheit.
*Badly disintegrated. Edges were spalled and the surfaces appeared soft.
†Edges were spalled a little on the sixty day specimens.

strength of the concrete cured under normal conditions.

The effect of NaCl alone, when added to concrete cured at low temperatures, is probably to reduce the freezing temperature and hence retard the freezing of the concrete, thus permitting its setting and hardening. The curves show an increase in strength for the addition of NaCl up to 12%, after which there is a decrease. It may be that, beyond 12%, the weakening of the concrete due to the excess of NaCl more than offsets the strengthening due to the reduction of the freezing temperature.

When $CaCl_2$ alone is added to the concrete, cured either at normal or at low temperatures, the effect is to increase the strength up to about 4% $CaCl_2$, at which point the maximum strength seems to be obtained. This increase in the strength of the concrete may be due to the acceleration of the setting of the cement by the $CaCl_2$. Serious disintegration was observed on the surfaces of the cubes cured at low temperatures and 6%, 8% and 10% of the $CaCl_2$. This disintegration did not appear on any of the cubes cured at normal temperatures or where NaCl was also used.

With concrete cured at low temperatures, the best effect seems to be obtained by using both NaCl and $CaCl_2$ in the mixing water. It is apparent that a 2% $CaCl_2$ and 9% NaCl mixture appears to give about as much strength as any of the mixtures tried, and, for the concrete cured normally, there is not a very great reduction in strength due to the addition of the salts in those percentages.

These tests were made with but one brand of cement. It is probable that there would be some variation in the results with other brands, but it is not thought that this variation would be great enough to affect the general conclusions.

It is also possible that some brands of common salt might contain a sufficiently high percentage of $CaSo_4$ to affect the results to some extent.

Contracting Economics and Adminstration

This very interesting paper by Dr. W. Sachs, abstracted from a recent issue of Le Ciment Armé points out, in a very emphatic manner, many pitfalls in administration to be avoided in carrying on a successful contracting business. A basic consideration of how forms and formwork should be accounted for is presented in detail.

The reinforced concrete industry presents some difficulties, at least in number, unknown to others; the manufacture of artificial stone alone offers similar difficulties, due to new equipment, the need of which is not felt, to technical ignorance and to lack of business knowledge. These things are not the cause of lack of success on the part of contractors in reinforced concrete, except in the case of small operators, who have permitted themselves to be drawn into undertaking this special work and have hastily gone out of the business, having burned their fingers. It may be stated that actually, in Germany, the great bulk of work in reinforced concrete is undertaken by firms with large capital, directed by engineers who are specialists, and by experienced business men. This is all the more reason for surprise at the frequent errors into which they fall. The matter is not to be explained by the closeness of competition. No one complains of lack of business, but it is nevertheless true that firms foolishly run after new business and in order to secure it do not hesitate to allow themselves to bid at prices which are not sufficiently profitable. Since the management cannot be accused of lacking technical and business knowledge, we are led to think that, if they appear to overlook the fundamental principle of all business dealings, "rather no business at all than business done at a loss," it is because they do not take into account real cost prices or they do not have a sound accounting system. A few examples will demonstrate our thought and the importance of errors which are committed.

There are some firms which by reason of their professional ability and the important undertakings which they have carried to a successful issue have acquired such a reputation that they are given new work without having it submitted to competitive bidding. These firms, being favorably situated and not being obliged to count every penny, can satisfy every rule of the art.

Price cutting Competition Undesirable

But, except in these unusual cases, work is generally let to competitive bidders. It is admitted that of late years some reforms have been introduced in these matters, at least so far as municipal undertakings are concerned.

The general objection to the system of awards and the abuses to which it gives rise, together with a clearer intelligence on the part of those who have the interests of good construction at heart, have largely served to improve the old customs. In many localities it is pleasing to note that the specifications are now more just to the owner and to the contractor and if this tendency is not more general, the delay must be ascribed to the difficulty of reconciling the interests of these two. There is a marked tendency to do away with the obligation to award the work to one of the three low bidders, since experience has shown that the principal factor of success of the enterprise is the integrity of the man who undertakes the work.

Unfortunately, these considerations are taken into account by few only, and there may be noted in the majority of tenders some striking differences between the high and the low bidder. These might be explained by the newness of the industry, comparing them with the slight differences noted in bidders on construction in metal, where the raw materials are priced on bases which vary very little. In steel construction, the conduct of the work plays an important role and the price of only a few pieces of work can be definitely fixed by regulation. The slight variation in the bids would result from the long experience acquired by iron and steel contractors, which permits them to know within close limits cost price and miscellaneous expenses. There are expenses which constructors in reinforced concrete do not take into account and among the latter is that of form work, which will be taken up later.

Dangers of Sub-contracting

There is one serious fault of certain managers, that of confiding their work to general contractors. There should be every confidence in the special training of the firm making the tender, that it limits its activities to concrete work. It is true that the general contractor makes easy the work of the managers dealing with him. But is there ever a contractor who knows all branches of construction equally well? No. So he goes to sub-contractors for carpentry work and masonry, whom he puts in competition and from whom he secures close figures, though at second hand. The dangers of such a method are obvious, since the general contractor, who cannot know everything, has not the knowledge necessary to control the work of his sub-contractors; and if he undertakes work outside of his specialty he runs the risk of running over his costs, which he has probably not calculated correctly, and may suffer a considerable loss.

Need of Specialists in Concrete Work

The constructor of reinforced concrete should refuse all general contracts and owners and architects should avoid giving work to general contractors. The practice simplifies their work but exposes them to serious consequences. In these modern times, specialization is a recognized institution; the constructor of reinforced concrete cannot undertake general contracts and, still less, build on his own account.

Many firms have a number of representatives who solicit their business. Their immediate sphere of activity is too small and work is sought at a distance, on all sides. The representative who is a favorite with his management announces that his firm can have a piece of work if it will consent to a reduction in price. So the firm reduces its price. But, a few days later, another firm makes still more advantageous offers for the same work. The representative counsels his firm to meet any competing bid, if it does not wish to be eliminated forever. The representative always gains his point; he cares little whether or not his firm suffers a loss; in any event, he has made his commission. A loss does not prevent his firm from being influenced in the same manner again, until, gaining wisdom through repeated losses, it rejects the representative's advice, and the latter, in a rage, goes over to the camp of the enemy.

Business at Cost Poor Policy

On other occasions, more frequent than is generally supposed, the contractor who has already been awarded some contracts at a good price, being assured of a good year, says to himself that he can accept some business at cost, thinking by this means to reduce his general expenses. This reasoning is simply self-deception, since the new work requires an increased force, if his ordinary staff is already occupied, as well as new material, with its wear and tear to figure on, and increased expenses of financing.

Bad figuring, outside of all technical valuations, which cannot be treated here, since we desire to limit ourselves to commercial considerations, is related to superintendence, which plays so large a part in the success of an enterprise. Unfortunately, honesty is not too common a virtue, and the activities of a few foremen may spell the ruin of an enterprise. We shall give one example only.

Handling the Purchasing Department

In one large undertaking, the foremen ordered the material direct from the supply houses and reported their purchases to the office, which made accounting to the management, expenditures being evidenced by vouchers checked by the office and therefore considered correct by the cashier. No irregularity could be suspected without collusion of three parties, the supply house, the chief bookkeeper and the contractor.

Nevertheless, a simple chance brought to light an abuse of confidence in a single enterprise amounting to more than 26,000 francs, which the three parties had divided.

Supervision here was lacking in two important points—a record of the arrival and the delivery of materials; a check record in the office of the value of materials ordered and used, and above all, the observation of the management, comparing these quantities with those normally observed.

Leaks in Figuring Form Costs

The weakest point in reinforced concrete contracting lies in figuring form work costs and carrying them inaccurately on successive balance sheets. Some firms credit the forms account with the quantity used in each job; others deduct at the end of the year from the debit of the forms account a certain percentage representing the estimated value of the wood used; still others take at the end of the year an inventory of stock on hand. No fault can be found with the latter procedure unless the reality does not correspond with the estimate—and here is the milk in the cocoanut. The percentage taken usually runs between 30% and 60%. The following figures will show the result of this variation. The debit to forms account being on the average 500,000 francs, the sum to deduct will be 150,000 francs for 30% and 300,000 francs for 60%. The result is that the balance sheet based on a 30% deduction appears very satisfactory the first few years, but the error will be very serious if it is not corrected in time. Let us confine ourselves to examining what takes place in a period of five years.

	30% Francs	60% Francs
1st yr.		
Investment in forms	100,000	100,000
To deduct	30,000	60,000
Debit balance	70,000	40,000
2nd yr.		
Investment in forms	100,000	100,000
To deduct	51,000	84,000
	170,000	140,000
Debit balance	119,000	56,000
3rd yr.		
Investment in forms	150,000	150,000
Total	269,000	206,000
To deduct	81,000	124,000
Debit balance	188,000	82,000
4th yr.		
Investment in forms	200,000	200,000
	388,000	282,000
To deduct	117,000	170,000
Debit balance	271,000	112,000
5th yr.		
Investment in forms	250,000	250,000
Total	521,000	362,000
To deduct	157,000	218,000
Debit balance	364,000	144,000

The balances based on 30% deduction thus appear to be more favorable than those based on 60% by the following sums:

1st yr.	30,000	francs
2nd yr.	63,000	"
3rd yr.	106,000	"
4th yr.	159,000	"
5th yr.	220,000	"

No one will admit that such differences are possible, that the enterprise could have accumulated, because of the 60% basis of figuring, 220,000 francs' worth of wood, which really ought to exist but does not appear in the inventory. The forms account ought to show, not 144,000 francs, but really 144,000 francs + 220,000 francs or 364,000 francs. Experience has amply shown that this is not true, that the deduction of 60% is proper and that there is available a stock worth 144,000 francs only. The firm that bases its figures on 30% is deceiving itself and its stockholders, while in reality it has suffered a considerable loss. Some firms escape this self-deception by taking an inventory of their stock of lumber every year, but this procedure is accurate only when the latter is estimated at its real value and not at its invoice value. To be perfectly secure it is proper to combine the two plans. The inventory is taken and the stock put in at its true value; at the same time figures are taken as above on the 60% basis and the less favorable of the two results is put in the balance sheet.

On current work, it may be estimated with a view to the figures at the end of the year, that wood can be used once and a half a year and that each use consumes one-half of the value of the wood, which amounts to figuring that the same wood can be used two and one-half times in all.

Essentials in Accounting

The accounting of work under construction is another rock on which the balance sheet may split. Suppose that it is a question of a firm with a capital of 1,000,000 francs, which desires to show a net revenue of 10%, or 100,000 francs. By taking work under construction into account, which may amount to several million francs, increasing or diminishing by 100,000 francs, this is an easy matter, even for conscientious managers; for deduction is a very elastic thing.

The law requires that the value of merchandise (and this must certainly include work under construction) shall be carried on the balance sheet at the cost price of the supply house and not that of the firm. The law, however, makes a wide difference between these two terms, meaning by the former an expenditure of any kind necessitated by construction, including raw material, salaries, inspection on the job, cost of operating machinery—in short, all the expenses *de visu*, whatever are the special conditions of the work being done. Therefore, one ought not to figure in this the general expenses of management, the depreciation of buildings and machinery, incidental expenses of the business and so on. If these expenses are added, the law indicates the figure obtained by the cost price of the firm, which, increased by the net profit, constitutes the selling price. It is unfortunate that not everyone is in accord in setting these figures in practice, and for this reason the item of work under construction ought to be estimated with great care; no one can have a proper idea of the exactness of the accounting without knowing the bases on which it is made. Examination by an auditor is not very valuable, since he has not the necessary technical knowledge and can rely only on the explanations given by the technical advisers of the management. I once ran across a case in which the accounting of the work under construction showed the profit hoped for and who knows how many similar cases there are?

I believe that cost price should include the following items:

Raw materials (sand, gravel, steel, cement, forms, etc.), to which should be added the costs of transportation and unloading:

All salaries and superintendence in the work:

Traveling expenses of the management and its representatives:

Material used on the job (nails, coal, grease, etc.):

Lumber for forms, estimated at 40% of its value, on the hypothesis that in the inventory of the lumber, 60% of its cost price has been deducted; if less is deducted the item of lumber used in work under construction shall be lessened to correspond.

No other expenses, including depreciation of machinery, shall be added.

There is still another source of error to be guarded against. Some firms carry on the balance sheet the expenses contracted at the supply house only; others determine what work is still to be done, and its cost price and figure the difference between the known expenses of this work and the total of the business. Both of these plans lead to grave mistakes. In the first case, it is not taken into consideration that the price on which the bid has been based may have been figured incorrectly, so that the completed work may represent a loss. In the second case, if one is content to deduct the work remaining to be executed, the balance sheet contains the total profit, even when the smallest profit must be overlooked.

To avoid self-deception, both methods will be used.

Here is an example, taken from actual work, which shows the differences in result, according to the method used:

The bid was 500,000 francs and in this sum were included 10% for general expenses and 6% profit. The net cost should, therefore, have been 500,000 francs less 80,000 francs, or 420,000 francs. In reality it amounted to 459,000 francs, or 7% more than was calculated.

The expenses shown by the balance sheet were 300,000 francs; in reality they should have been lessened by 7% and 279,000 francs written.

The different procedures of accounting would have given:—

(1) 30,000 francs, or 21,000 francs too much.

(2) Figuring a fraction of the general expense of the whole contract, 300,000 francs + 35,000 francs, or 56,000 francs too much.

(3) Taking the percentage of the profit, 300,000 francs + 35,000 francs + 21,000 francs; or 77,000 francs too much.

(4) Taking the price of the bid, less the work still to be done (a very popular method) 500,000 francs — 141,000 francs = 359,000 francs, or 80,000 francs too much.

(5) It would have been accurate to deduct from (4) the estimated general expenses and the profit, or 359,000 francs — 80,000 francs = 279,000 francs, and this figure would have been adopted because it was lower than (1) and still it would not have been very close to the actual facts.

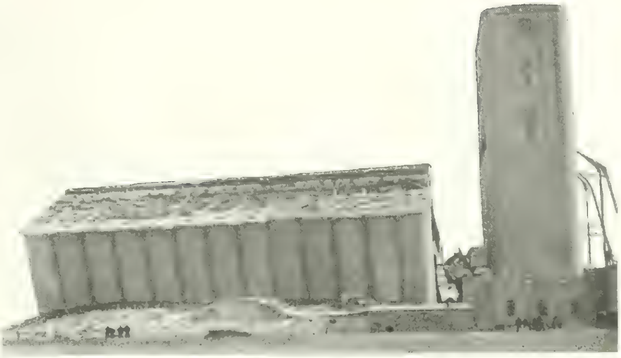


Fig. 1—A Reinforced Concrete Grain Elevator at Transcona, Near Winnipeg, Which Has Settled and Taken an Inclined Position Without Any Structural Damage

Subsidence of Concrete Grain Elevator at Transcona

NEAR WINNIPEG A GREAT GRAIN ELEVATOR, *a group of 65 cylindrical bins, has settled and tipped to approximately 30° from the vertical. Some foundation condition, developed without warning, forced this great structure to adjust itself to a new base, but today the reinforced concrete bins are structurally intact. They have been emptied of their grain, new and better foundations will be placed, and the elevator will be, it is planned, jacked back into position. Truly, reinforced concrete is a wonderful material.*

An accident which has aroused a great deal of interest among the contracting and engineering interests throughout Canada, and which presents some features of unusual interest, occurred recently at Transcona, a town located a few miles from Winnipeg, Man. On the morning of Oct. 19 the huge storage tanks in connection with the Canadian Pacific Ry. elevator began to subside, the movement being sustained for nearly 24 hrs. By that time the whole structure comprising the tanks had subsided on one side over 20 ft. into the ground, at the same time tipping over to an angle of about 30° from the perpendicular and sliding an appreciable distance to the west. The ground displaced by this movement has been thrown up into a mound of earth nearly 25 ft. high, and it is against this mound that the cylindrical sides of the tanks are resting.

Adjacent Building Shows No Movement —Wonderful Showing of Reinforced Concrete

One of the most extraordinary features of the occurrence is the fact that the transfer house has not moved at all, but is standing apparently as firmly as ever. The movement of the tanks has broken the steel trestle which connected them to the transfer house without disturbing the stability of the latter. Another and still more remarkable point, and *one which emphasizes the value of reinforced concrete as a building material in a most conclusive manner*, is the fact that in spite of the great and unanticipated stresses, that must have been created in the structure on account of its movement and by the changes in the direction of the forces due to the weight of the contents of the tanks, which consisted of of 855,000 bus. of wheat, *no cracks or flaws have appeared in the reinforced concrete walls of the structure*. A further testimonial to the qualities of concrete construction was afforded by the tapping of the tanks to permit the introduction of the belt conveyors with which they were emptied. This necessitated cutting considerable openings in the walls, and presented something in the nature of an experiment. The fact that this was successfully accomplished under conditions of quite unusual stress reflects the greatest credit not only on the form of construction under notice, but also upon the designers and builders of the tanks, and the engineers who carried out the work of tapping them.

Work of Restoration

The excellent condition of the tanks has led to a decision on the part of the railway company to restore them. The contract for this work has been awarded to Barnett & McQueen, the contractors who originally built the elevator. It is anticipated that this work will involve the expenditure of about $30,000. The general scheme of restoration will be to build a false foundation for the solid concrete mass of the structure and then to set about the construction of true foundations of the caisson type, which will go down to bed rock. The elevator

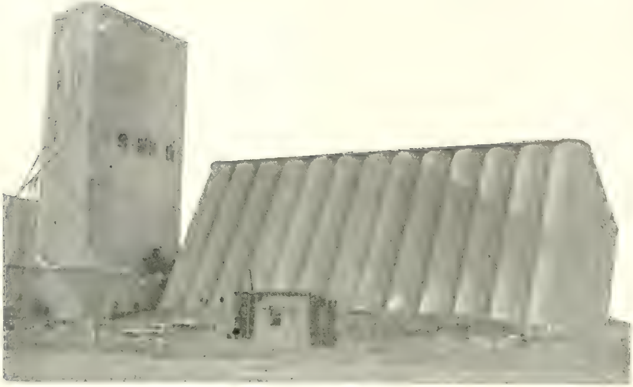


Fig. 2—A View of the Grain Elevator at Transcona Taken from a Point Opposite from Where the Illustration in Fig. 1 was Taken

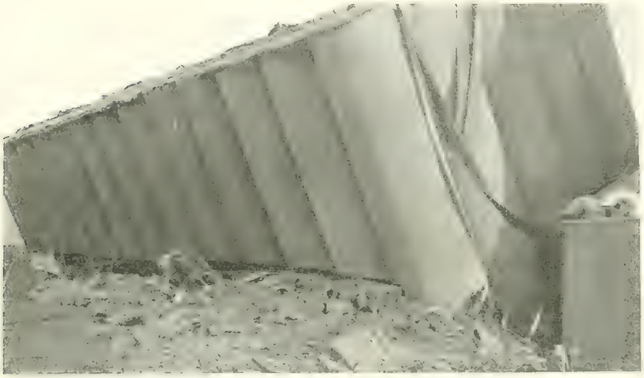


Fig. 3—A Detailed View of the Grain Elevator Taken from About Where the Men are Standing at the Right in Fig. 1

will then be jacked up onto these foundations, the jacks resting on the false foundations. The work involved will be considerable, and will be of a delicate nature, the problem being rendered the more complicated on account of the difficulty in obtaining a good false foundation in the poor bearing strata of the Transcona district.

The cause of the subsidence is not known. The foundations employed were of the floating type, which consists of a mattress of strongly reinforced concrete of an area sufficient to carry the proposed maximum load by distributing it over a large surface of ground. It is probable that in this instance insufficient preliminary data were obtained and that the bearing capacity of the clay was overestimated, while it is also possible that unanticipated water action has weakened the underlying strata. But whatever the cause of the occurrence it is generally admitted that the form of construction employed in the structure could have had nothing to do with it, and that had any of the other types been employed the results would have been much more serious, and probably quite impossible of rectification.

A Low-Cost Poured Concrete House

The man of wealth can afford a frame house with its high cost of upkeep, painting, repair and fire risk; the poor man cannot afford such continual expense. Economy demands for him a permanent type of construction where the first cost is practically the only cost. At Virginia Highlands, a suburb of Washington, D. C., among a group of 25 poured concrete houses, there is a small cottage which would seem to fill the great need for better and less expensive houses.

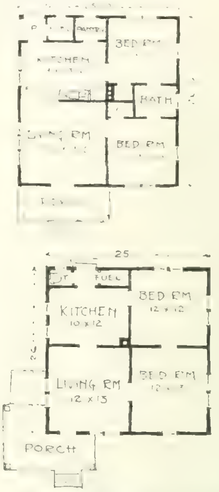
Cinder Concrete Used

This building is of poured concrete, but instead of the usual gravel or crushed stone, clean coal cinders, a waste product in most sections, has been used in the mixture, cement and lime only being added. This use of cinders reduces cost materially.

Walls Poured In a Single Day

The rapidity of this new method of house building assists materially toward economy; the forms were put up for the entire house, windows and door frames dropped into place, and the concrete was poured in a single day. The following day the wedges were driven out, the forms removed and taken to the next job.

The design of this cottage is striking in its simplicity, planned to give the compactness and conveniences of a city flat; the low pitch permits the use of slag or gravel roofing, making this permanent and largely fireproof. A unique plan was adopted for the foundation, since the cellar has been omitted. Square holes were dug of proper size and these filled with concrete to the grade level. The steel forms were set up resting upon the earth and extending over these piers, reinforcing bars being' dropped in to strengthen the unsupported wall between the piers. The walls are 6" in thickness, reinforced with steel bars over and below the windows and doors.



Alternate Plans of One Story Concrete Bungalows

This new method of house pouring has been developed by Milton Dana Morrill, architect, of Washnigton, D. C., as a means of carrying out his plan of permanent, sanitary, inexpensive houses. There has been a great and universal need for better housing conditions, and it is evident that reinforced concrete is doing much to fill this want. Several hundred of these houses have now been constructed in various parts of this country and abroad, and steel form equipment is fast supplanting wood centering.

The families occupying houses of this kind at High Lake, a suburb of Chicago, state that during the two past severe winters they have proven dry and especially warm, making an additional saving in fuel.

The cost of this house here shown is from $1,000 to $1,250 each, according to local conditions, but as the process is largely one of machinery, several houses must be built at one location to effect the greatest economy.

The Cause and the Prevention of Cracking in Concrete Roads

BY HENRY S. SPACKMAN*

In several of the recent papers discussing the construction of concrete roads, published in CONCRETE-CEMENT AGE, there has been a tendency to question the need of placing expansion joints at intervals of 25′ or 30′, several writers ascribing the formation of cracks in concrete roads to causes other than change in volume of the concrete itself. This is particularly noticeable in A. N. Johnson's discussion of Frank F. Roger's paper at the Third American Road Congress (see CONCRETE-CEMENT AGE for Nov., 1913, p. 217). As Mr. Johnson's paper epitomizes the new thought along these lines, we shall use it as a text for this paper, in which we desire to support the conclusions drawn by Mr. Johnson from the observation of the behavior of roads themselves, by data obtained in our laboratory. Briefly summarized, Mr. Johnson attributes the formation of cracks to unequal settlement of the sub-grade, supplemented by the external stress due to the passage of heavy traffic, or to the movement of the slab under temperature changes. In this we concur if by temperature changes is understood the action of the frost in causing movement of the sub-grade, as well as the effect of variations in temperature upon the volume occupied by the concrete.

We do not, however, agree with Mr. Johnson's statement: "It can be fairly assumed in the present instance that the slabs of concrete may be considered as approximately of the same strength and therefore offer practically the same resistance to all exterior forces to which they are subjected." In our opinion, in many cases, the concrete slab is not a continuous structure, but consists of a number of pieces of various sizes in close contact, but without bond, the cohesion between the several pieces having been broken by microscopical hair-cracks, formed by shrinkage caused by the draining off through gravity of the excess water during the first few hours after the concrete has been placed, at which time the material has little or no strength. These natural lines of cleavage form lines of weakness, along which the concrete is easily fractured by external force, which ordinarily would not cause sufficient stress to overcome the cohesion of a solid concrete slab.

The extent to which the drainage of the water from the concrete may cause shrinkage within the first 24 hrs. is clearly illustrated by Curve A in Fig. 1. The curves A and B show graphically the change in volume obtained by measurement of two test pieces 1 m. long and 10 cm. square cast from a mixture of 1 part cement and 3 parts washed gravel, having the following granulometric composition:

Size of Sieve	% Passing	% Passing Previous Sieve and Retained on Next
1″	100.0	0.0
¼″	90.5	9.5
No. 10	79.5	11.0
No. 20	68.7	10.8
No. 30	58.1	10.6
No. 40	40.1	18.0
No. 60	20.1	20.0
No. 100	6.7	13.4

Details of the Test

The abscissae in the several figures show the periods of time at which the measurements were taken; the ordinates show the calculated movement in a length of 100′. The two test pieces from the measurement of which the curves in Fig. 1 were plotted were made from the same material, cast at the same time from the same batch and exposed under identical conditions, that is, 4 das. in air out of doors, balance of time in water; the only difference noted being that in one case, the mold permitted a more rapid leakage of the exuded water than in the other. The test pieces remained 48 hrs. in the molds, after which the sides and ends were removed. The mortars were purposely made sufficiently wet to allow the test pieces to be cast by pouring without any tamping.

Fig. 2 shows the average expansion and contraction of a number of similar test pieces, half of which were placed in the water at the 4-da. period and half in air in a room. These curves show certain typical characteristics, which persist with little exception in the curves of some 60 test pieces under observation. These are a more or less marked shrinkage up to the 24-hr.

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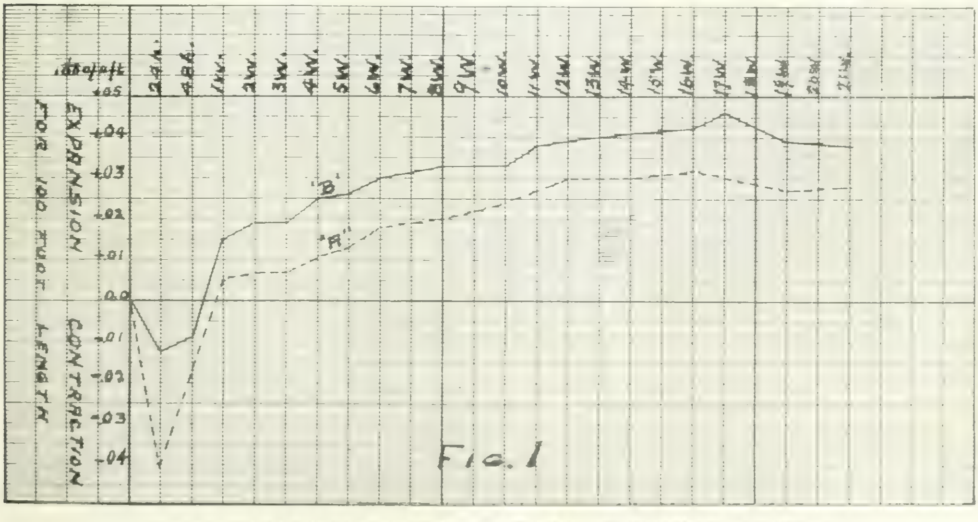
*Henry S. Spackman Engrg. Co., Philadelphia.



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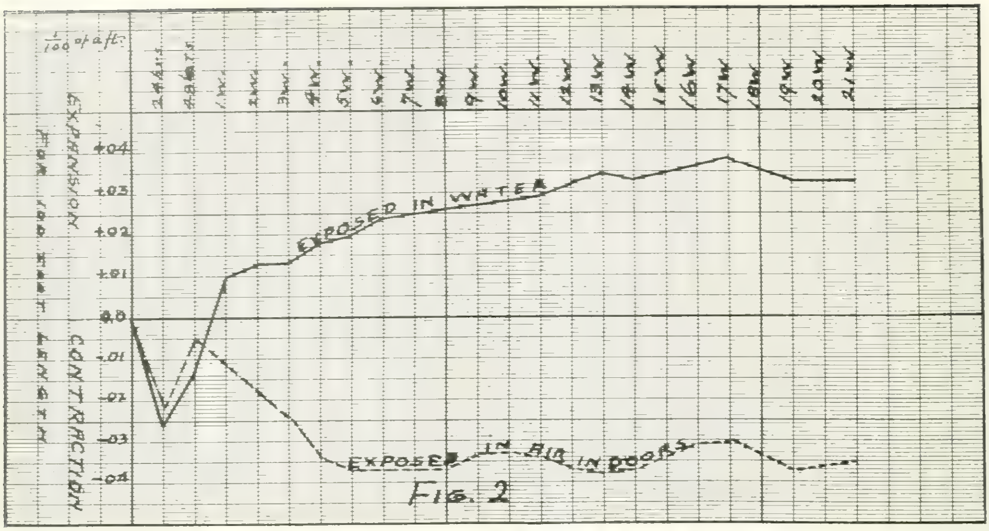


FIG. 2

Fig. 2—Shows Average Contraction and Expansion of Concrete Test Pieces

period, due to the draining off of the water, followed by an expansion at the 48-hr. period, probably caused by the hydration of the cement, followed by a practically continuous expansion for all test pieces in continuous or intermittent contact with water, such test pieces at the end of the 3-mos. period occupying more space than when originally cast. When the concrete is kept from contact with water, the test pieces being stored in air indoors, there is an equally continuous shrinkage after the 48-hr. period.

By comparing the curves A and B in Fig. 2, it will be noted that there is a possible range in the change of volume amounting to 0.08′ in the length of 100′, but that this theoretically possible change in volume is not likely to be encountered in actual practice in road construction is evidenced by the curves in Fig. 3. These show the expansion and contraction in a length of 100′, calculated from measurements obtained from six concrete test pieces, 6′ 6″ long, 18″ wide and 6″ thick, laid on clay soil out of doors, exposed to the full influences of the weather with no special provision for drainage, the natural surface of the ground, which was level, having been excavated to a depth of 6″ so as to bring the top of the pieces flush with the surrounding ground. The object was to approximate as closely as possible the conditions actually encountered in road construction. While the test pieces have not been subjected to extreme cold, they have been exposed to all the changes of weather in Philadelphia from July to November, which included range in temperature from 96° to 32°. From study of concrete in actual use in road construction by Mr. Johnson and our laboratory investigation, it would seem that we are absolutely warranted in assuming that the change in volume due to climatic influences after the concrete has hardened is not sufficient in itself to cause the cracking noted in concrete roads and that except in localities having distinctly marked wet and dry seasons, no such variation in length through changes in moisture content and temperature as shown in Fig. 2 is probable.

If we are correct in assuming that the cracking of concrete roads is due to

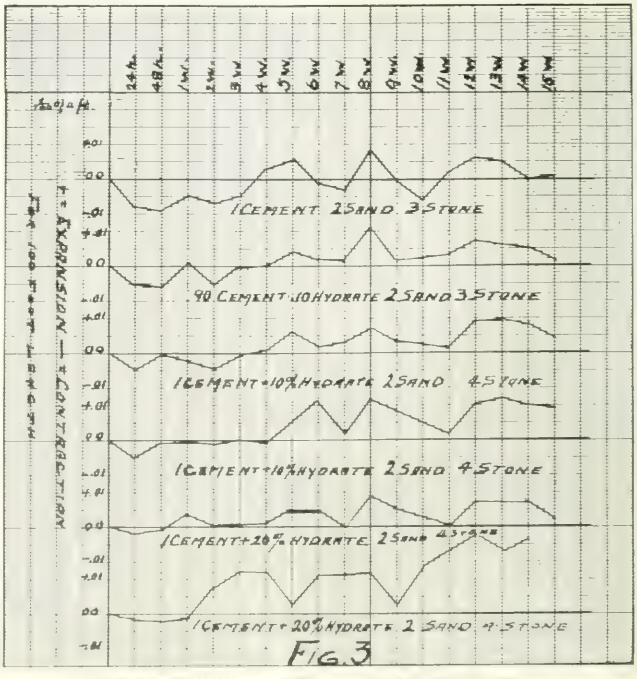


FIG. 3

Fig. 3—Contraction and Expansion in a Length of 100′

external forces acting on slabs previously weakened by the formation of hair-cracks, caused by the draining off of the water immediately after placing the concrete, it is evident that if this could be overcome cracks would be reduced to a minimum, and the greatest objection to concrete roads would be met, for, besides being unsightly, cracks and expansion joints are elements of weakness, since they offer to the passing vehicle points for attack, at which wear first starts.

Keeping Water in the Concrete

It is also evident that the present practice of covering the concrete and keeping it wet for some time after laying is not effective in that it is applied too late. The loss of water through exudation and seepage cannot be overcome, except by the use of watertight forms, combined with a practically impervious sub-grade (which conditions are impractical), or by the addition to the concrete of some material, which, while without detrimental effect on the resulting strength, will tend to hold the water in the concrete until it has obtained sufficient cohesive strength to resist the tensile strains occasioned by shrinkage through draining off of the excess water.

Use of Hydrated Lime

From information gained by the previous study of similar problems involved in the cracking of cement plasters and stuccos, it was determined to experiment with hydrated lime for this purpose. A comparison of the measurements of 18 test pieces to which hydrated lime was added with those obtained from nine test pieces containing no lime shows a marked reduction in the contraction at the 24-hr. period, the average contraction for the 18 test pieces containing hydrated lime being 0.007% against 0.015% for the nine test pieces containing no hydrated lime.

These laboratory tests, in connection with the observation of the laying and subsequent behavior of two short stretches of road, laid with concrete containing hydrated lime—one being built at my suggestion by Logan Waller Page, Director, Office of Public Roads, United States Department of Agriculture, at Chevy Chase, Washington, D. C., and the other by H. M. Clark, Road Engineer of Wicomico County, Maryland, near Salisbury—led me to believe that the addition of from 10% to 15% of hydrated lime to concrete used for road construction will be found beneficial, not only in reducing cracks, but also in eliminating the formation of holes and soft spots. The addition of hydrated lime makes the mortar surrounding the coarse aggregate more plastic and viscous, the effect of which is not only to hold the water, but also largely to eliminate the separation or segregation of the cement from the sand or the coarse aggregate; this results, naturally, in making a more homogeneous slab, and lessens the liability to the occurrence, through carelessness of the workmen, of pockets of material deficient in cement.

The Dome of the Melbourne Library

The new structure for the Melbourne Public Library, Melbourne, Australia, is octagonal in plan, and consists of an inner wall built of brickwork, with four steel stanchions extending from basement to the spring line of the dome and carrying four of the ribs thereof. The exterior to this is an outer brick wall, symmetrical with the inner wall and 15′ from it, forming an annulus right round the main building. There are in addition two annexes containing stairways and book stacks. The central octagonal space contains basement, ground and first floors; the annulus contains basement, ground, first and three upper floors; portions of these upper floors on four sides are carried forward into the central octagon in the form of cantilever balconies.

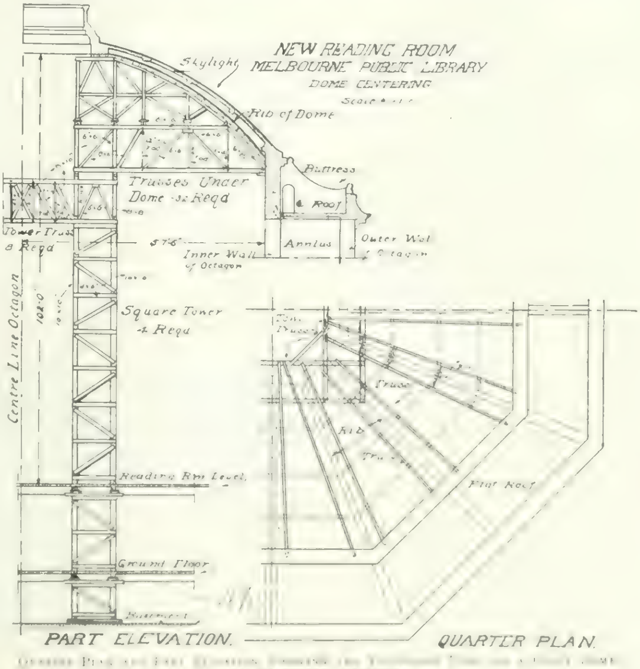
The central portion is roofed over with a dome springing from the inner walls of the octagon with buttresses therefrom to the outer walls. The annulus portion is covered by a flat roof. The height from basement to apex of dome is 150′ and the clear height from the first or reading-room floor to apex of dome is 116′. The reading-room is 115′ across from side to side of the octagon, which gives a floor area of 10,957 sq. ft., with a height of 80′ to the spring line of the dome. All the floors and columns carrying the floors are built in reinforced concrete on the beam and slab principle and presented no special difficulties, except at the points of intersection of the eight large beams at the center of the octagon of the main floors—at these points the rods of the beams were attached to specially constructed steel angle cogs placed over the columns to give the necessary continuity and rigidity. The dome, 126′ in diameter between centers of tension band, is an octagon covering an area of 20,750 superficial ft.

The Dome Centering

The main items of interest from the structural standpoint are the dome and the method of its construction. The dome is composed of 16 arched ribs, varying in size from 48″ deep and 24″ wide at the spring line, to 24″ deep and 18″ wide at the crown. These ribs spring from the inner walls of the octagon and are surmounted by a lantern light. The lantern is an octagon, 34′ in diam. The arched ribs are connected by three purlins and the dome plate or slab pierced for the necessary light between these purlins. The paneling between the ribs is filled in with a concrete slab 6″ thick, reinforced with trussed bars.[1]

The method adopted for the erection of the timbering and centering and the placing of the concrete was as follows:

Four square wooden towers each 10′ square and well braced were erected



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[1] Trussed Concrete Steel Co., Detroit

from basement on solid ground to a height of 95′. Spanning from tower to tower a pair of wood and steel trusses was built, thus making eight of these trusses. Above these and bearing on them, 32 wood and steel trusses were placed spanning from the main trusses over the towers to the walls, two being placed under each rib of the dome. From these trusses the timbering for the ribs, purlins and slab was carried. Wooden wedges were placed under all vertical posts and struts and at suitable points for slackening when required.

On completion of this timbering the whole of the reinforced steel work of the ribs and purlins was placed in position, also the heavy reinforcement at the spring line and around the central ring under the lantern light to take up the thrusts from the ribs.

Placing the Concrete

For the purpose of placing the concrete a platform was erected above the central lantern light and cerried by the centering below. An electrically operated hoist conveyed the mixed concrete from the basement of the building to this platform where it was dumped on to the platform and immediately shoveled by hand through hoppers in the floors of the platform, discharging into the heads of chutes, by means of which it was conveyed by gravity to the point required on the dome. The mixing was done entirely by hand, using a 1:2:3 mix, with Portland cement, clean, coarse sand and bluestone, passing a ¾-in. ring.

The chutes used to convey the concrete from the platform to the various points were made in portable lengths of sheet iron with a timber support at the bottom, and were 12″ wide and 5″ deep. The slope of the chutes was approximately 30° to the horizontal and it was found that the concrete mixed fairly wet ran down the chutes evenly and without any segregation of the constituents. The concrete was discharged directly into the position desired, where it was continuously rammed, and spaded into position round the reinforcing bars. In this way about 8 cu. yds. of concrete were placed per hr. In placing the concrete the buttresses were first done and the heavy ring at the spring line of the dome, suitable toothings and skewbacks being left to take the concrete to be placed subsequently. In placing the concrete in ribs the main angle ribs were done first, the two opposite corner ribs and portions of the adjacent purlins and slab were carried up simultaneously from the spring line to within 4′ of the ring at the apex each day. This was found to constitute a day's work. The intermediate ribs were then similarly constrtucted, thus bringing all the ribs up to within 4′ of the ring at the apex, the concrete in each case being stopped with a face at right angles to the axis of the rib at that point and extra bonding rods put in.

Procedure in Placing Concrete

The concrete ring at the apex was then placed in one day, special care being taken to give good bond to old concrete surface by cutting the latter back and grouting well in cement mortar

The concreting of the remaining portions of the purlins, slab and walls of lantern light was then proceeded with. As soon as possible after the completion of the concrete work the whole of the exterior face of the dome was surfaced with a 1:3 mortar and finished with a steel troweled surface. The timber centering was left in position for four months and was then gradually eased by slacking off the wedges on top of the timber trusses. These were slacked off from the spring line, first working towards the center.

Initial Deflection

The total downward deflection of the apex of the dome on the removal of centering was 3/16″; this was measured by means of a graduated rod suspended from the apex of the dome and read by a surveyor's level stationed on the roof over the annulus.

The dome is by far the largest reinforced concrete dome in the Commonwealth and is claimed to be the largest in the world. The total cost of this building including the dome, exclusive of fittings, was £66,900 ($325,134).

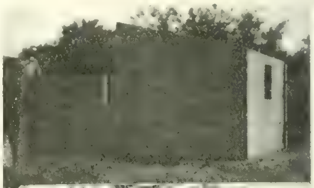
The architects for this structure were Bates, Peebles and Smart, Melbourne. It was built by the firm of Swanson Bros., Bldrs., Melbourne. The design of the reinforced concrete was handled by the Trussed Concrete Steel Co., Ltd., London, through Chas. A. Reed, engineer and manager of the Sidney, Australia, office of that company. To the builders, the architects and the engineer we are indebted for the foregoing notes.

Three-Room Houses for $194.80 in Egypt

The Egyptian Delta Light Railways Co., ltd., owns and operates 1,050 kilom. (625.34 mi.) of lines in lower Egypt, and employs in connection therewith some 3,000 men. In the July, 1913, issue, a brief article told how this company has built very low cost concrete cottages for its employees. The unit cottage for the lower class of employees, who earn about $5.97 a month, costs about $58.00. This unit consists of one room and a courtyard. The next unit in the ascending scale, which is intended for employees who earn from $9.74 a month to $14.60 a month, consists of two rooms and a courtyard and costs $121.75. The three-room unit which is built for station masters and employees earning from $19.50 to $29.00 a month, costs $194.80.

The construction methods which were briefly referred to in the July issue are more fully explained in the accompanying illustrations. In this method the entire side of the cottage is cast horizontally on the ground and raised into place by native workmen using ordinary wooden beams as jacks or else a winch and shear-legs. In Fig. 1 are shown the forms in place and part of the slabs cast for a house. Figs. 2 and 3 show other stages in the same work. In Fig. 2 the slabs are in place and a native laborer is wiring the reinforcing mesh together at the corners. At the extreme right is shown the corner of the vertical form in place which has been grouted in. The roofs are of galvanized iron.

The further notes and photographs have been kindly forwarded by Edw. J. Harran, Asst. Mgr. of the Egyptian Delta Light Rys., Cairo, Egypt.



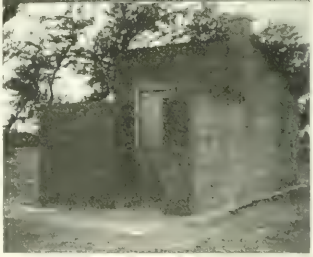


Fig. 2 (Above)—The Wall Slabs in Place: At the Left is Shown a Laborer Lacing the Corners Together

Fig. 3 (Below)—A Completed Single Unit

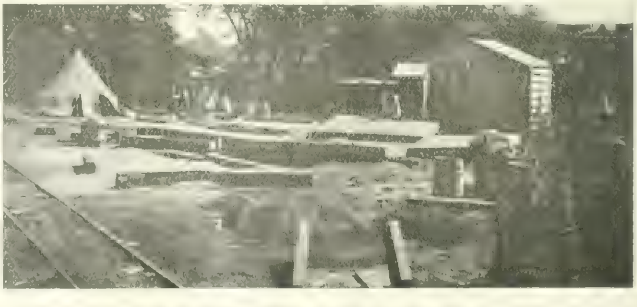


Fig. 1—Forms in Place and Part of Slabs Cast

Waterway Structures*

BY A. R. HIRST†

Among the most important considerations affecting the construction of public roads is that of drainage. The life of every road structure depends upon the drainage given it, and the culverts and bridges necessary must be built not only to serve the purpose of drainage, but must serve also the convenience and safety of travel. The failure of a road results only in the additional expense necessary to replace it in proper condition, but the failure of a bridge results also in the suspension of travel, and if it occurs at the wrong moment, may cause considerable loss of property and possibly injury or death to those traveling the road.

For many years both the design and erection of highway bridges was practically entirely in the hands of the steel bridge companies, who used their opportunity to the utmost and decorated the landscape with structures which had little to commend them except the fat prices they brought from an unknowing public.

Within the last few years, however, many states have created highway commissions which have effectually taken up the problem of bridge design and a considerable change for the better has occurred, both in the strength of bridge superstructures and in the foundations, more especially in the latter, which was the point at which most of the older structures were especially deficient, if one point of weakness can be selected from the mass of general ineffectiveness.

A properly designed waterway structure should fulfill the following requirements:

1. Waterway sufficient to carry off promptly the water coming to it.
2. Proper foundations to bear the loads, resist undermining, and give long service.
3. Superstructure designed to bear for a long period of years any load which may legally be imposed upon it.
4. Superstructure wide enough and so constructed as to serve the comfort and convenience of travel.
5. Economy of maintenance.

A sixth factor, that of esthetic design and fitness of the structure to the surroundings, has been and is little considered in bridge and culvert design, but will probably be demanded more and more as public appreciation of the value of pleasing design grows.

In the short compass of this paper we cannot enter into a discussion of bridge design, or give any details of any specific type of structure. We shall, however, give some account of our standard practice in the state highway work in Wisconsin, and probably this will be sufficient evidence of our views as to what constitutes a proper waterway structure.

Wisconsin is a state aid state, and gives state aid to bridges and culverts as well as to road construction. All waterway structures 6′ and under in span are classed as culverts, and are built out of the funds available for the construction of the road. All waterway structures over 6′ in span are considered as bridges and must be provided for by separate appropriations, the state paying 20% of their cost instead of 33⅓% as in the case of culverts on roads.

Wisconsin has a drastic bridge law which provides that culverts under 18″ in span must be so constructed or reconstructed as to stand without planking a load of 18 tons, and waterway structures over this span must be designed, "in accordance with standard engineering practice," to stand a load of 15 tons without planking.

In addition to the duty of designing all state aid bridges and culverts, the state highway commission has imposed upon it by law the duty of approving as to their safety and engineering sufficiency the plans of all bridges constructed with county aid. In the seven seasons of the existence of the Wisconsin Highway Commission and its predecessor in highway work, the Wisconsin Geological and Natural History Survey, we have designed about 1,000 highway bridges of a span exceeding 10′ for counties, and about 400 bridges exceeding 6′ in span, and innumerable culverts under this span for the state aid construction. In addition to this, we have approved the plans for probably 500 bridges not designed by our engineers, but simply checked as to engineering sufficiency. Actual culvert and bridge construction under our own designs has cost about $2,000,000.

Wisconsin Classes of Bridges

We may roughly divide our bridge superstructures into five classes as follows:

Class 1. *Spans from 18″ to 10′.* Almost invariably constructed of reinforced concrete of the slab type. We are building even the smallest culverts of reinforced concrete, as we find in Wisconsin that they are entirely serviceable, easily constructed, and in probably 50% of the cases cost less than any other type of culvert except wood, which is not allowed on any of our work. The smallest concrete structure we are now building is 18″ x 12″, as we have found the smaller sizes equally as expensive and very easily blocked with ice and debris.

In some cases where the foundation conditions are extraordinarily soft and difficult, or concrete materials are not reasonably available, we use culverts of corrugated metal with concrete or stone end walls, but such culverts are used only where it is impracticable to use concrete, and probably not 1% of our culverts are now built of this material. Vitrified clay is not used at all on state aid work, as culverts of this material have been found almost invariably to crack by filling and freezing. Concrete pipes molded in place and afterwards moved to the job are not used for the same reason. Under conditions favorable to their use, both make excellent culverts, and we could recommend them in less severe climates. Cast iron water pipe has not been used on account of fits cost, which invariably exceeds that of concrete.

We find in the small concrete culverts from 18″ to 10′ the average cost per cu. yd. complete, including the excavation and back-filling, is about $8.00, and very seldom runs above $10 per cu. yd.; sometimes as low as $6.00.

Class (2). *Spans 10′ to 40′.* Either reinforced concrete, the slab type up to 18′ and the through girder type up to 40′, or I-beam structures with concrete floors are used. We are building many true reinforced concrete bridges, but with public lettings open to any bidder, the workmanship and finished appearance have been so poor in many cases that we are using more I-beam structures than we otherwise would. In the case of I-beams, a 5-in. concrete floor is placed on top of the I-beams, and the corrugated arch type of support for the concrete between the I-beams is but seldom used.

Class (3). *Spans from 40′ to 80′.* We are using the Warren riveted pony truss practically exclusively, though a few plate girders are being used where the conditions of hauling are favorable. All of these structures have concrete floors.

Class (4). *Spans from 80′ to 135′.* We use the riveted Pratt high truss with a horizontal top chord, also with a reinforced concrete floor.

Class (5). *Spans over 135′.* We use a Pratt riveted high truss with a curved top chord. Practically all of these larger spans are also built with a reinforced concrete floor. Very seldom do we use a pin connected truss, either for Class 4 or Class 5, probably not once in 25 cases.

Cost figures

From our cost figures on all bridges so far constructed, we find that for any span the price erected (including substructure and superstructure) figures out very closely to $40 per lin. ft. of the over-all span. Reinforced concrete floors average about 20 cts. per sq. ft. Steel in plate girder and truss spans averages from $25 to $70 a ton erected, and I-beam spans figure from $50 to $60 a ton erected.

We have adopted for widths for concrete culverts and bridges the standards recommended by the Association of State Highway Departments, which are as follows:

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*Presented at American Road Congress, Detroit, Sept. 29 to Oct. 4, 1913.

†State Highway Engineer of Wisconsin.

First Class Roads.	
Culverts under 12′ span, minimum width	24′
Slab Bridges over 12′ span, minimum width	20′
All other concrete spans, minimum width	20′
Very long bridges less if necessary.	
Second Class Roads.	
Culverts less than 12′ span, minimum width	20′
Slab bridges over 12′ span, minimum width	18′
All other concrete bridges, minimum width	18′
Third Class Roads.	
Culverts less than 12′ span, minimum width	20′
Slab bridges over 12′ span, minimum width	18′
Longer bridges may be, minimum width	16′

Steel bridges are built almost invariably with a 16′ roadway; that is, 16-ft. clear distance between trusses or rails, no matter what the class of road, although for spans under 80′ some 18-ft. clear roadways have been built.

Abutments under practically all structures are plain concrete, as with concrete materials as cheap as we have them in Wisconsin, and with the difficulty of getting first-class workmanship in reinforced concrete foundations without constant inspection, we find that this is the cheapest type of abutment. Occasionally cement rubble masonry abutments are used, and once in many times driven steeel I-beam piles surrounded by a concrete wall are used. The last type of abutment has been found to be very satisfactory and economical for high abutments on sandy bottoms, and has largely displaced the use of cylinders with steel backing. Steel backing is not allowed on any state aid structure. The price of concrete in bridge abutments and piers averaged last year about $8.00 per cu. yd.

A large share of the trouble with bridge structures results from improperly designed foundations. A common fault is stopping work before a proper depth below stream bed is reached. Seldom should foundations extend less than 4 ft. below stream bed, and whenever doubt as to the bearing power of the soil at that point is entertained, or as to undermining from a rapid stream, they should be carried down to solid soil or thoroughly piled. All foundation work should be inspected as the excavation is made and material is placed, not necessarily by an engineer, but at least by an honest man with good judgment and backbone. All concrete work in any part of the structure should be inspected as it is placed. Inspection of steel and workmanship on it as it is erected is not so necessary, as it can be inspected and its compliance with the specifications determined after erection at the time acceptance is to be given.

As to methods of letting the work. We have found it necessary to have open competition and sealed bids on bridge work, and by asking for mailed bids on all work have established true competition and have to a very large extent broken up the old system of "pooling," and combinations of the bridge agents who may be on the ground at the letting. We furnish complete plans for foundations and for reinforced concrete, I-beam and plate girder spans, and all bidders submit prices on our uniform plans. For truss spans, we furnish the truss diagram showing the stresses in the truss members and the make-up of the truss members, floor system, and principal connections, and the successful bidder submits for approval the shop drawings before fabrication is begun. For trusses we believe the latter system is preferable to that of furnishing complete shop drawings, as it allows manufacturers to follow their standard shop practice in detailing so long as these details are satisfactory.

The proper design for culverts and bridges is an engineering problem which should always be left to engineers. Probably a state highway department can handle it more economically than can private engineers, as so many bridges will be built of one span that superstructure plans can be standardized and even the same foundation plan may fit several bridges. The cost of designing, letting and accepting bridges in Wisconsin has averaged us about 3½% of the total cost. Inspection has been paid for separately by the local units. It would probably be better to have a state inspector on each bridge, but we have gotten very good results through local inspection at probably 25% of the cost of placing a man on each job. Important jobs should have a skilled inspector by all means.

A Discussion of Wayne County, Michigan, Concrete Roads

Readers of this magazine, which has published a great deal about concrete paving in general and Wayne County, Mich., work in particular, will be interested in an editorial discussion from the *Engineering Record* simply because it gives an angle of opinion for the general engineering field. It discusses Wayne County roads as follows:

Nearly five years ago the first concrete road in Wayne County, Mich., was built near the town of Wayne.[1] Since then the mileage has been increased year by year, and with it the fame of the system itself. Next week it will be subjected to a scrutiny hitherto unknown in its history, for the cohorts attending the Road Congress will descend upon it, examine it both in a friendly and in an inimical spirit, and thresh out its merits and demerits in the corridors of convention hall and hotel. Even with this program in prospect it is not amiss to call attention to some of the features of the Wayne County work, for many engineers will be prevented by distance and other causes from participating in the inspection and the subsequent discussion. A fuller account of the system and methods will be found elsewhere in this issue.

While the original road is still in excellent condition and shows the typical mosaic surface characteristic of even wear, errors have been made in experimenting with leaner mixes, kinds of joints and numbers of courses. Nevertheless, one readily sees on inspection that the work is in the hands of men who are advancing the art of roadbuilding at a rapid pace, avoiding the repetition of mistakes as soon as they are apparent. It is to their credit that not a single slab put down by the commissioners has been removed.

Concrete in roads undoubtedly gets harder usage than in most other forms of concrete construction. Each surface stone is hammered continually by the traffic passing over it, while the structure as a whole is subjected to considerable stress in carrying loads from its surface to the foundation. The impact on the surface stones is severe, while unevenness of surface and irregularity at expansion joints increase the shocks to which the pavement is subjected. In consequence, the Wayne County officials use a rich mixture, 1:1½:3. This is the nominal mixture, but actually the sand is apportioned to more than fill the voids between the stone. An extra effort is exerted to get the surface true, especially at the expansion joints, where troweling away from the iron strips has given much better results than troweling toward the strips. Even brief consideration of the difficulties of the work will convince one that it requires the best of workmanship, a richer concrete, better inspection and supervision, more careful holding to grades and protection from drying out than almost any other kind of concrete construction. These things seem to have been well appreciated in Wayne County.

Maintenance, too, has been put on a sound basis. The concrete roads receive careful attention the season following construction in the way of tar coating on and in all expansion joints and accidental cracks, most of which develop within that period. So well do the men with the tar pots do their work that it is not uncommon to find pits caused by a single 1 or 2-in. loosened stone covered with a splotch of tar. This splotch is eventually ironed out to a formidable looking patch of 12 in. or more in diameter. Larger holes where some raveling has taken place due to insufficiency of mortar are cleaned thoroughly before applying the gravel and tar.

Armored expansion joints are put in at an arbitrary interval of 25 ft. This figure corresponds very well with observations recently made by a representative of the *Engineering Record* on a California concrete road, 4 in. thick and 15 ft. wide, which was to be covered with oil. In a distance of 1,120 ft. the cracks appearing within a month of the time of laying averaged 28 ft. apart, but varied from 6 ft. to 75 ft.

Finally a word is needed on the general conduct of the work. It was found at an early stage that the contract system could not, or at least did not, give the required results, so the day-labor method has been in vogue. Expending annually $600,000, employing, housing and feeding as many as 1,000 men per month, purchasing and unloading 1,200 cars of material per month and keeping

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[1] The first concrete road was on Woodward avenue, just north of Highland Park. The work had not progressed on Michigan avenue westward as far as Wayne for a couple of years.—Editor.

$100,000 worth of equipment in trim would be considered in a private business a sufficient reason for the employment of a corps of high-salaried officers, a retinue of clerks and bookkeepers, to say nothing of a force of engineers, inspectors and foremen. When it is learned that the paltry sum of $6225 was expended last year for supervision it is readily apparent why the Wayne County system has been studied with more than usual profit by communities in other sections about to enter on a roadbuilding era.

A One-Piece Clamp For Curb Construction

Concrete curbs are today a standard item in modern street improvement. Over a year ago CONCRETE-CEMENT AGE published an article describing the one-course sidewalk work in Salt Lake City. Sometime after that article appeared we had an inquiry for further information on the metal yoke used to hold the curb form in place and, pursuant to our request, the city engineer of Salt Lake City has sent us the accompanying notes and accompanying illustrations, showing this curb yoke in detail.

This clamp as shown is designed for a standard section of concrete curb and would have to be modified to suit any standard section as adopted in various localities.

The clamp is practically a U-shaped yoke of essentially a T-section with bolt holes at either side, through which bolts are passed to hold the clamps in place. The bolts used pass through the iron clamp and through the vertical cleat at the side of the form. Where two forms join, the bolt passes through both cleats with the U-clamp between them. These clamps are made in Salt Lake City by a local foundry, but could be made by any foundry having the facilities for casting.

Design and patterns were made by a local contractor and the clamps were produced at a cost of approximately 80 cts. apiece for cast-iron clamps and $1.35 for cast steel clamps. So far there seems to be no patent on this form of clamp.

The County Council, of Essex County, Ont., a distinctly rural community, has decided to submit a by-law, Jan. 1, 1914, for $1,000,000 to be applied to the construction of concrete roads. Windsor, the county seat of Essex, has a few concrete streets, but the famous roads of Wayne County, Mich., are right across the river, and the farmers of Essex are thoroughly familiar with them. They have not only seen teams drawing tremendous loads with ease, but realize that these roads make excellent sidewalks as well as general traffic highways, a phase of the subject that appeals tremendously, as it means absence of mud and dust throughout the year. For these reasons Essex County farmers propose making an appropriation proportionate to some of the very largest state appropriations now under consideration in this country.

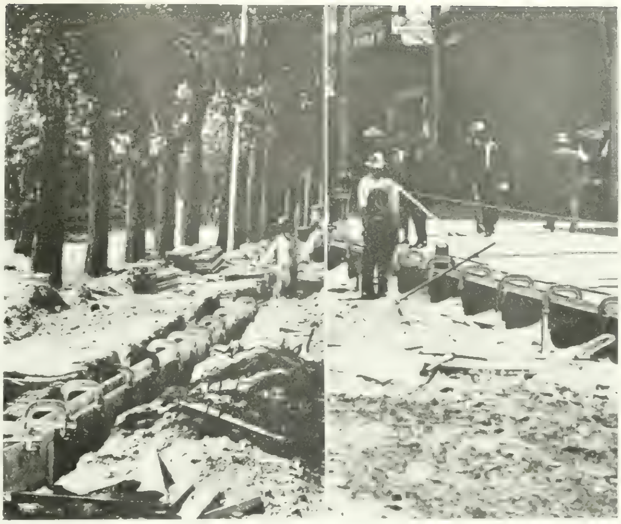
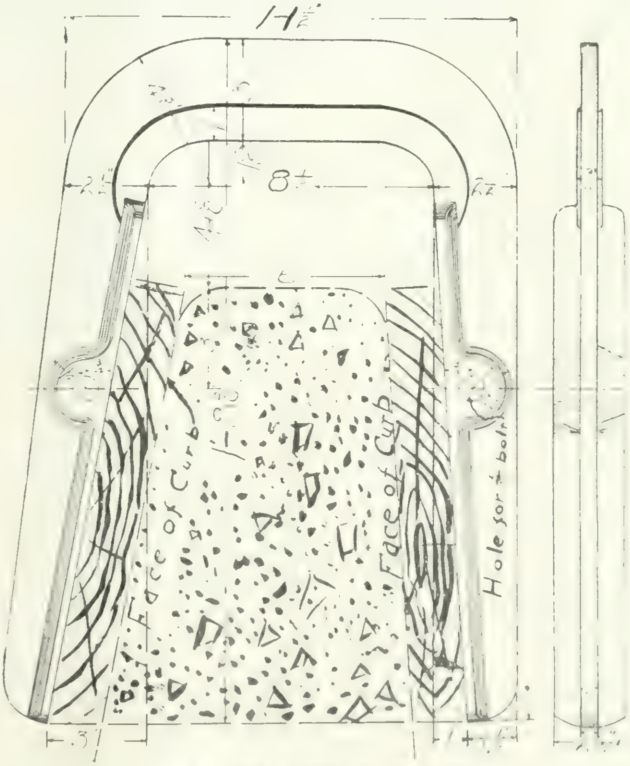


Fig. 1—Curb Construction in Salt Lake City, Using a Cast Iron One Piece Clamp



[illegible] Clamp
[illegible]

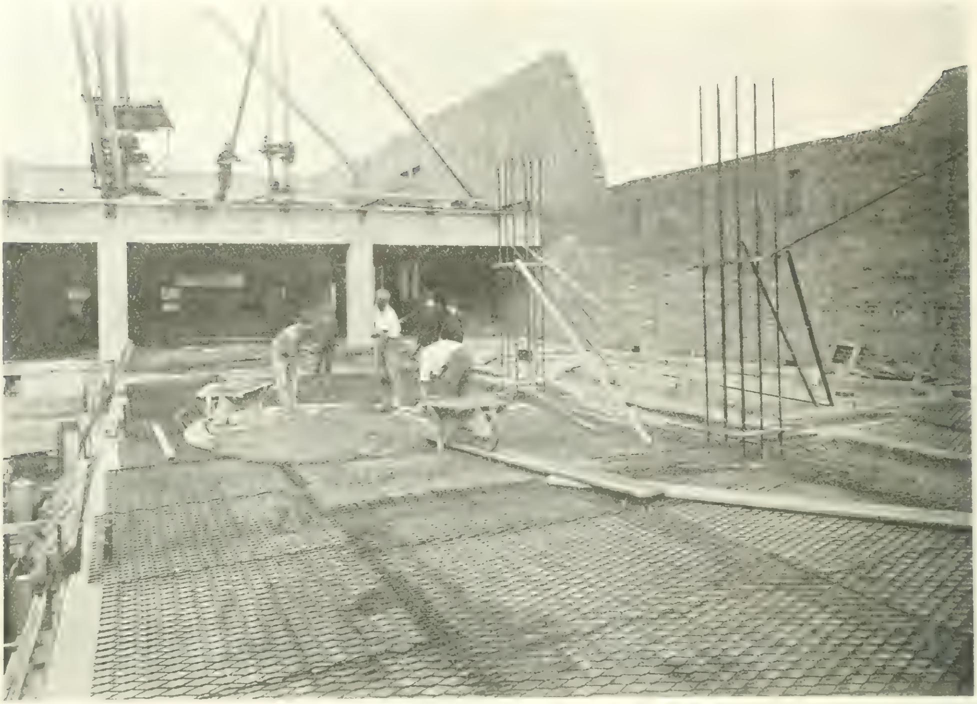


FIG. 1—PUTTING REINFORCED CONCRETE FLOOR IN SYDNEY, N. S. W.

The floors in this building, a brewery warehouse, are designed to carry a load of 600 lbs. per sq. ft. Note the expanded metal reinforcement, and the trussed steel to take care of negative bending

Notes on Reinforced Concrete in Sydney

The adoption of reinforced concrete in general building construction is steadily increasing in Sydney although the operation of an obsolete building act is doing much to retard progress within the municipality. It is also probable that the comparative cheapness of high-class brick, and local sandstone of a superior character, has had a great deal to do with conservative adherence to old methods in the construction of the many large and imposing buildings recently erected. Reinforced concrete, however, for interior construction shows a considerable amount of development and Elliott, Maclean & Co., Sydney, who, as the representatives of the Expanded Metal Co. were some years ago practically pioneers in that field, report several large works recently completed and in progress.

The new building for the State Registrar-General, just completed, is a handsome building of Sydney freestone in Tudor-Gothic style designed by the ex-government architect, Col. Vernon. The floors are entirely of concrete reinforced with expanded steel and the beams and columns are protected by concrete with steel lathing. All the corridors are shut off by fireproof doors operating on the automatic principle and the window frames and sashes are of steel, so that the nearest possible approach has been made to a fireproof structure.

A new building, also designed by the government's department, for the Railway Parcels Post, is in sandstone and red brick and presents a handsome appearance. The whole of the internal construction is on the expanded metal system.

Now approaching completion are two fine buildings for Tooth & Co., Ltd., the well known Sydney brewers. One is an aerated water factory and the other a beer bottling establishment of the most up-to-date description.

The interior work of both these structures is in concrete reinforced with Kahn trussed bars and rib bars in the beams and columns and expanded steel in the floors. The cart and loading docks were designed to carry a working load of 10,000 lbs. per sq. ft. and the floors 600 lbs. per sq. ft. The architects were Spain & Cosh, the concrete designers and supervisors, Elliott, Maclean & Co. and the contractors, C. Lidbury & Son, all of Sydney.

Many sites throughout the city of Sydney and the adjoining suburbs have been natural gullies and watercourses loosely filled in, and hitherto have carried only small, light buildings, but owing to the rapid growth of the city, both commercially and industrially, these have had to be utilized for larger and more important structures. In other instances the original soils were of treacherous descriptions of clay, showing constant movement under climatic conditions.

Raft Foundations Used

The problem as to the best method of economically providing secure and stable foundations for the modern types of buildings now required was a somewhat difficult one, but Elliott, Maclean & Co. specialized on the subject in their reinforced concrete designing, with uniform success.

One site, on which a large commercial block has been built, is over an ancient stream which many years ago was diverted into pipes, now forming part of the city drainage. This was loosely filled in with foundry ashes and road rubbish. A raft formed of reinforced concrete beams and a complete flooring slab with expanded steel has proved entirely effectual. On another site, piles were driven in clusters, capped with concrete reinforced with expanded steel and connected by beams reinforced with Kahn trussed bars, the system of beams forming footings for the walls and columns.

The large new markets erected for the City Council were on a very difficult

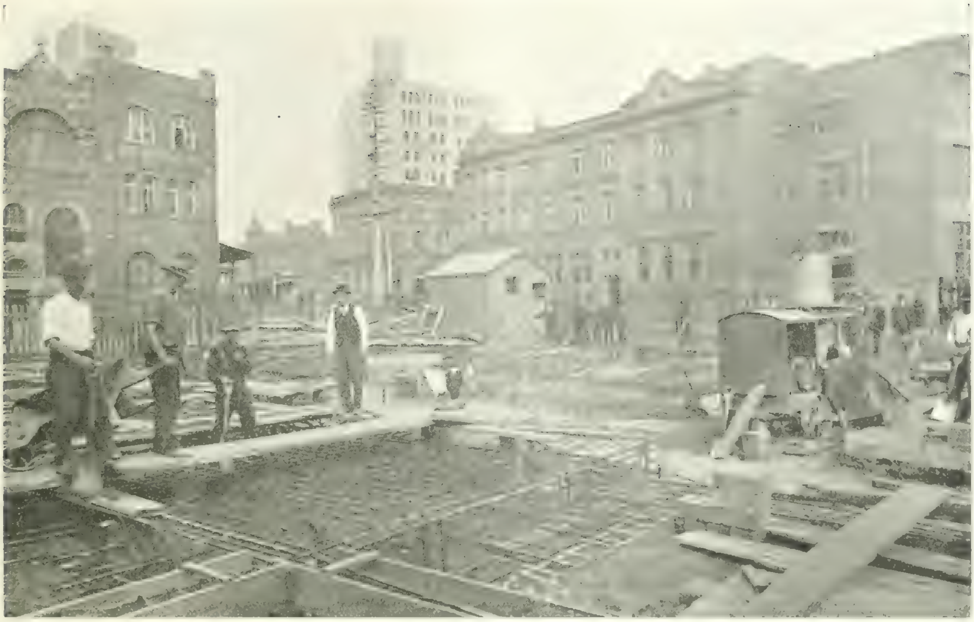


FIG. 2—A RAFT FOUNDATION ON [illegible] GROUND
This is foundation work for the Coffee Palace, Sydney, N. S. W.

site, but all troubles were overcome by a reinforced concrete raft foundation.

One of the latest foundations is for a coffee palace now in course of construction for the City Council. This was designed by the engineer of the Trussed Concrete Steel Co. resident in Sydney. The reinforcing material is being prepared, shaped, etc., by Elliott, Maclean & Co. who are the agents in New South Wales for that company.

It will be seen therefore that Australia is not without notable examples of reinforced concrete construction, although circumstances have rendered the development less rapid than could have been wished.

Notes on Building Construction in India

Writing in a recent issue of the *Daily Consular and Trade Reports*, Consul Henry D. Baker, on special commercial service, states that one of the most significant recent developments in connection with the construction of large buildings in India has been the increasing use of American reinforcing steel for concrete construction and of various American roofing materials made of heavy wool felt, saturated with gummy compounds to render them waterproof. The use of expanded metal and reinforcing bars, imported from the U. S., has greatly increased economy in recent construction of buildings in India, as such material, when used in the erection of walls, floors, and ferro-concrete roofs, saves labor cost and space, and is said also to be cooler and more sanitary than native material. Its extensive use in India has been specially promoted by one Detroit firm,[1] which employs in India trained engineers from the U. S., who, on arrival in India, make careful study of local conditions and then furnish technical advice, supervision, and selling assistance to the different local agents for this product. They take care that contractors in charge of buildings using such reinforced steel make no technical mistakes in the use of such material in building construction.

Housing Development in Calcutta

Reinforced concrete construction is most in evidence in Calcutta. The Improvement Trust of that city has lately made a choice of such method of construction for the first experimental blocks of buildings now in course of erection for the poorer classes, at Manicktollah, a suburb of that city. This project is intended to accommodate persons displaced from other improvement blocks and comprises the provision of 248 rooms, each 12′ x 12′ with a 4-ft. veranda, and opening onto a central passage 7′ wide. The structures will be in blocks 200′ long and three stories in height, with latrine accommodation at either end. All flooring and roofing are on the expanded metal system of reinforced concrete construction. Some thousands of feet of reinforced brickwork are also being used. The floors are designed to carry a live load of 75 lbs. per sq. ft., over 6-ft spans, the floors being 3″ thick with concrete in the proportions of 1:2:4, the expanded metal reinforcement consisting of No. 15 metal, 3-in. mesh, ⅛-in. strands. Rapidity of construction and economy in cost were two of the deciding factors in adopting the above system for these buildings.

Among other important buildings lately erected in Calcutta employing reinforced concrete construction may be mentioned the telegraph office extensions (staircases and balconies), stamp and stationery office, ladies' annex, United Service Club, Bengal Nagpur Ry. Offices, Government House and Government House kitchens, Bengal Club, Indian Museum, etc. In Bombay this method of construction has lately been employed in the substation of the Bombay Electric Light Co. and in the large new sawmill of McKenzie's (Ltd.), of this city.

Laborious Methods—Official Inspection—An Opening for Sawmills

Building operations in India have hitherto been noted for undue cost and unwieldy construction in many particulars. For instance, it may be mentioned that the Taj Mahal Hotel in Bombay, the largest in India and one of the most recently built in Bombay, despite the great cheapness of native labor, cost $1,330,000 and took nine years to construct. Steam power was used for pumping out the foundations, grinding mortar, and for cutting up scantlings, but the sawing of logs and every other work was carried out by manual labor. Lifts, or elevators, were established on the completion of the building, but all the material of construction was raised, even to the top of the dome, either by hand winches or on the heads of coolies who walked up and down very steep gangways of rough bamboo. There were no woodworking machines employed except one circular saw.

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[1] [illegible]

Building Activity

Building operations in Bombay as well as in Calcutta are at present active. New houses are generally five stories to six stories in height, and yet there is nowhere a lift carrying building materials nor any pneumatic machine at work for carrying the soft sandstone used so much on façades. In construction, however, of the new docks in Bombay, now in progress, the best modern appliances are being used.

An Indian Mortar Mill

The Indian mortar mill consists of an edge runner stone, working in an annular trough about 20′ in diameter and 18″ deep. The stone is fixed on a pole hinged to a central pin at one end and attached at the other to a draft animal that works on a circular path of about 16-ft. radius. Its value complete is about $50. The trough is roughly lined with masonry, and mortar ground in it is rarely free from lumps. Brick joints are therefore wide and the settlement great in proportion. Winches and pulley blocks are used without oil, and the favorite method of raising weights is lifting by rope and blocks with a gang of men, who pause after each pull, while one of their number often chants a refrain.

Introducing More Efficient Methods

Possibly there would be a field in India for American architects and building contractors, who might introduce more efficient and economical methods and thus make buildings cost much less and give more safety and comfort. It would be necessary, however, in such instances to study local peculiarities and desires in architecture and to construct buildings or dwellings with a special view to their reasonable coolness in the intensely hot summer climate that prevails through most parts of India. The bungalow type of dwelling in India is well adapted to the country, and in its main essentials would always be required.

Most dwelling houses in India are owned by native landlords, who are used to Indian methods of building and might be disinclined to employ American architects or builders, especially if the American plans showed greater expense than those to which they are accustomed. However, in erecting especially fine buildings, as in the case of office buildings, banks, hotels, and Government buildings, there would seem to be a reasonable chance of good architects and builders finding remunerative work. There is undoubtedly room in India for foreign real estate and building construction firms with sufficient capital to buy land in desirable localities, erect houses of approved modern types, and rent them at good rates to the transient but well-to-do European population.

Near Newport, R. I., the Bur. of Yards and Docks of the Navy Dept. is planning to build a concrete wharf for the U. S. Naval Torpedo Station.

Handling Bulk Cement in a Small Plant.

Within the last year much attention has been directed on every hand toward economies in handling bulk cement. The acompanying sketch shows a suggested arrangement which has been sent in by Gordon Wilson of the Universal Portland Cement Co., Chicago, who has taken the lead in this work. In the letter accompanying the blueprint Mr. Wilson states that this outfit has never been tried out in actual practice, so he is not prepared to state definitely that it would be an absolute success as designed. There are probably several details which would be smoothed out in construction and operation. In fact, Mr. Wilson points out two details that might be open to question, the first of these being the slope of the long chute which runs from the head of the bucket elevator to the mixer hopper, and he states that there is a question whether or not this is sufficiently steep to insure a free downward flow of the cement. Mr. Wilson's letter continues substantially as follows:

In designing this equipment we have tried to conform to the following essentials:

1. It must be as inexpensive as possible.
2. It must contain as little machinery as possible.
3. It must afford storage capacity for a little more than an average carload of cement.
4. It must be capable of being installed in a comparatively low structure.

This equipment consists, first of all, of a circular concrete tank such as might be built by anyone owning a set of silo forms, although a wooden tank properly designed would do the work just as well. Inside the tank a sloping false floor has been built, so that the contents of the tank will drain down to the opening "A". The other essentials are a bucket elevator with provision for driving it, a chute with a swinging door leading from the car door to the foot of this elevator, and a long chute leading from the head of the elevator to the mixer. At the foot of this long chute are two slides by means of which the cement may be measured into the mixer. In the upper part of the chute is a trap door, "B", opening into the tank.

Our idea is that when a carload of bulk cement is being unloaded, the open-

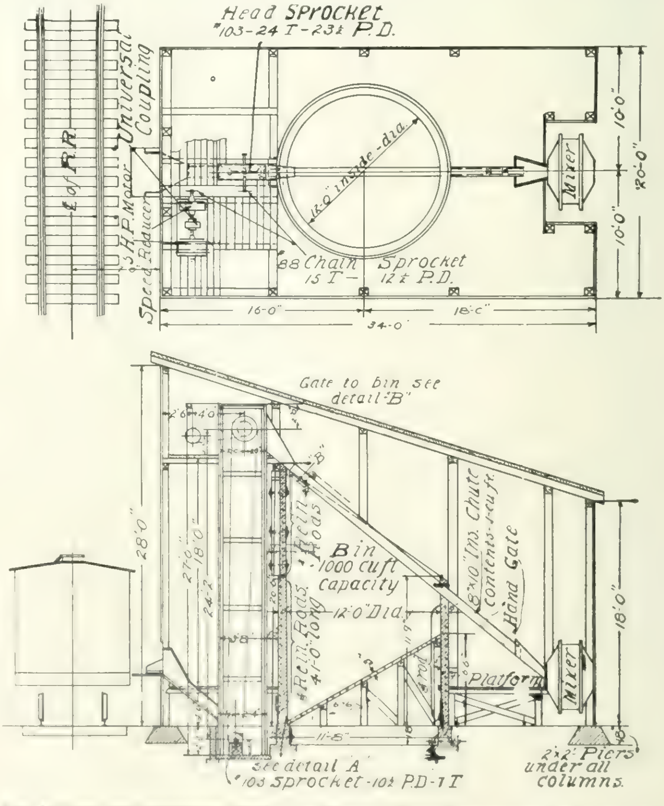


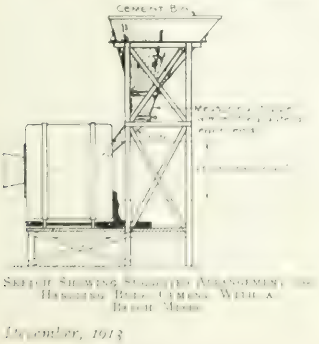
Fig. 1—Plan and Longitudinal Section of Suggested Plant Arrangement for Handling Bulk Cement

ing "A" would be closed by means of the gate provided for that purpose, and the opening "B" would be opened. The cement would then be shoveled or wheeled and dumped into the chute leading from the car door. The chute would deliver it into the bucket elevator, which would carry it up into the long chute from which it would fall into the tank through opening "B". If cement were required while the car was being unloaded, "B" might be closed for a few minutes, allowing the lower part of the chute to fill up. When cement is being used from the bin, opening "B" would be closed and "A" opened, thereby allowing the cement to run down from the bin into the elevator boot. The elevator would then carry it up and deliver it into the long chute, through which it would run directly down into the mixer hopper.

The other materials could be wheeled over the platform provided for the purpose and dumped into the hopper.

The following estimated cost of this equipment should not be taken too seriously. In the first place, all the prices of machinery, etc., are gross catalog prices and are actually subject to discount. The prices for lumber, labor, etc., will vary considerably in different localities. The layout of the plant may be such that the elevator may be driven from a line shaft that is already in operation, which would materially reduce the cost of the installation.

Description	Price
Concrete in bin wall, 22 cu. yd. at $10 cu. yd.	$220.00
Concrete in bin wall foundation, 6 cu. yd. at $5 cu. yd.	30.00
Concrete in bin pit, 1½ cu. yd. at $5.	7.50
Concrete under wood cols., 3½ cu. yds. at $5 cu. yd.	17.50
53′ 0″ No. 103 chain with attachment every fifth link	53.50
1-HD sprocket No. 103 chain 24 T.-23½ P. D.	11.20
1 lt. sprocket No. 103 chain 17 T. 16¼ P. D.	8.05
30′ 0″ 8-in. x 10-in. chute wood complete	25.00
4 1 15/16-in. rigid pillow blocks	14.00
3 1 15/16-in. safety set collar	4.00
5′ 0″ 1 15/16-in. shafting	2.50
46 6″ x 4¼″ x 4″ buckets	29.00
1 bin gate	7.00
Reinforcing rods, 25 ⅜″, 41′ 0″ long, 15¼″ 41′ 0″ long, 500 lbs.	10.00
500 ft. B. M. of 1-in. x 6-in. for elevator	15.00
250 ft. of 2-in. x 4-in. for elevator	7.50
250 ft. of 6-in. x 6-in.	7.50
1 wood spout complete	5.00
1 speed reduction	20.00
1 5 h. p. motor	130.00
1 universal coupling	30.00
13′ 0″ No. 88 chain	5.00
Total	[illegible]



Sketch Showing Suggested Arrangement for Handling Bulk Cement With a Batch Mixer

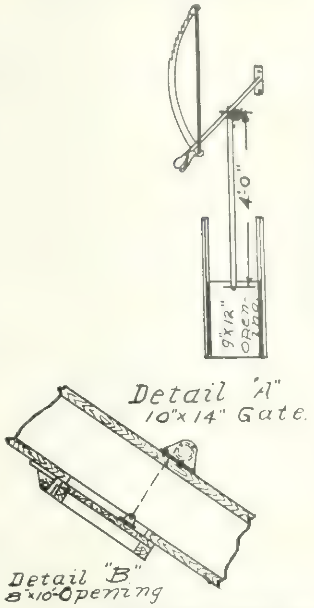


Fig. 2—Detail of Bin Gates for Bulk Cement Handling Plant

A Suggested Hopper for Bulk Cement

A large concrete pipe concern in Chicago has been considering the use of bulk cement in its plant, and the accompanying sketch shows a bin and measuring hopper suggested for its use by L. A. De Vore[1]. In the suggested plant the cement is to be placed in a bin above the mixer; and there is a short chute leading down to the mixer. In this chute, a pair of sliding doors makes a chamber by which the amount of cement for a batch can be measured. The arrangement is clear from the sketch, and may suggest adaptations which should be suitable in a good many situations.

Work of the German Cement Commission

The German Assn. of Portland Cement Manfrs. has established a technical committee for the purpose of studying the various questions of the highest interest in the art of reinforced concrete construction. There has been provided for these researches a credit of about $240,000 covering subventions of the Kingdom of Prussia, of the German Empire, of the Beton Verein, of the Cement Verein, of the Soc. of Civ. Engrs. and of the Soc. of Mining Engrs. These generous subventions show on the one hand the importance that manufacturers of cement and engineers attach to the development of the applications of this new material, and on the other that there are still many points to elucidate not only in the theory but also in the practice in this art, which has had a quarter of a century of development only.

The greatest of the subventions was that of the Prussian State and after that comes that of the Assn. of Portland Cement Manfrs., recognizing the considerable progress that this industry owes to the development of reinforced concrete. A great number of tests of beams have been undertaken, and the beam tests will be conserved in the cement museum at Heidelberg for the instruction of visitors and also of contractors.

Among the questions studied at Dresden may be mentioned tests of T-beams under dead loads; researches on the influence of vibrations on resistance of concrete, coming either from the pounding of the concrete or the passage of heavy wagons. In studying the influence of variations of loads it has been found that the effect of 150,000 repetitions was unnoticeable.

To demonstrate further the protection of steel and iron against rust, experiments will be made on beams and on small pieces of iron covered with concrete.

The Architect and the Builder

An architect or an engineer who is handling a large job has to settle many questions regarding details which are not made explicit in the specifications. It is in his power to make things run smoothly and with a minimum of expense, if he so wills it. He may, on the other hand, by lack of good judgment, so impede the smooth completion of the work as to cause serious loss to the contractor who has taken the job on a lump sum basis, or corresponding loss to the building owner where the contract is upon the cost-plus-percentage or cost-plus-fixed-profit basis. In this connection, Leonard C. Wason, pres. Aberthaw Const. Co., Boston, in a recent paper read before the Boston Soc. of Civ. Engrs., states that on work for an architect who was well known to rule always in favor of his client in all contentions on the work irrespective of the merits of the case, the careful bidder, after figuring full measure on all quantities, added this item: Humor architect. This item was 10% of the contract, and it is safe to assume that other bidders placed this contingency at even a higher figure.

The example quoted above is by no means exceptional. Long experience in the work of various architects and engineers teaches a contractor just what can be expected from those men in given contingencies—establishes their "personal equations," in other words. It is obvious that the best results can be obtained both in expense and in lack of friction where the guiding mind is an eminently impartial and judicial mind, and works for the best interests of the client, irrespective of the exigencies of the moment. It is quite apparent that deciding everything in favor of his client is not to the best interests of the latter, nor of his own reputation or business volume; this for the reason that his peculiarities become quickly known to contractors, and are always allowed for in the preparation of a bid.

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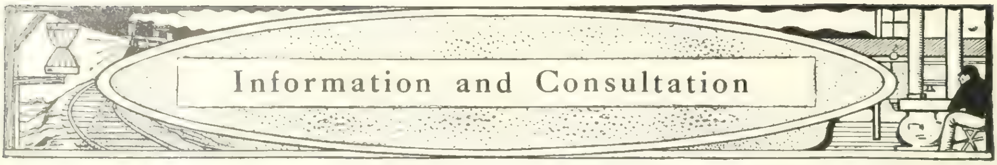
[1] Standard Scale and Supply Co., Chicago



Information and Consultation

We learn best by doing. This department is a place of exchange between those men who know from specialized experience and those men who want to know. The Discussions are specific and direct. In the following pages the topical heads show the many lines of activity in the concrete field which are covered. Questions and Discussions are cordially invited

276. Articles on Concrete Boats and Barges

"May we have reference to articles recently published on concrete boats and barges?"

276. Discussion by C. W. Boynton[*]

In regard to literature on concrete boat development, we learn from our reference files (*Cement World,* Aug., 1911) that several years ago Frank A. Furst, pres. of the Arundel Sand & Gravel Co., Baltimore, was interested in the construction of an 80-ton barge for service in supplying coal and fresh water to the river dredges operated by the company. Later (*Cement & Engineering News,* June, 1913) we find reference to the launching of a 500-ton scow by the Furst Concrete Scow Construction Co., Baltimore.

Concrete Engineering for Dec., 1910, contains an article describing the construction of a reinforced concrete scow that was launched at Fort Dalhousie, Ont., in November of that year and intended for general use in the maintenance work on the Welland Canal. This scow was designed by W. H. Sullivan, Asst. Superintending Engr. and the work was done under the supervision of J. L. Weller, Superintending Engr. of the Welland Canal.

About four years ago Oscar F. Lackey, Harbor Engr., Baltimore, was granted a patent on a reinforced concrete boat or barge, and an article describing it appeared in *Cement Age* for Feb., 1910. We do not know whether or not any boats have been built according to his designs.

Moechel & Lowther Engineering Co., Kansas City, Mo., made some experiments about five years ago (*Cement Age,* Oct., 1908) with models of concrete barges, with a view to learning whether or not such barges would be suitable for navigation on the Missouri and the Mississippi river, but there is no reference as to whether or not any full sized boats have since been constructed according to their designs.

A construction somewhat similar to concrete scows and barges is the floating concrete dock which was built by Geo. A. Whitehead & Co., Owensboro, Ky. This was described in *Concrete Engineering,* Jan., 1910.

285. Sweating of Concrete Roofs

"We have had considerable difficulty with the condensation of steam on the underside of a concrete roof. The water caused by the condensation drips on to the machinery and is quite an annoyance. We are now building an addition and wish you would suggest some way of obviating this annoyance."

285. Editorial Discussion

Cinders can usually be used to provide sufficient insulation and prevent condensation. In the use of cinders, however, it must be pointed out that there is a serious objection due to the lapses of time between the casting of the roof, the placing of the cinders and the placing of the waterproof cover of tar and felt over the cinder fill. This point is emphasized in a recent paper by L. C. Wason, President of the Albertfaw Const. Co., Boston, who states that in a good many instances the elapsed time referred to above permits a quantity of rain to collect in the cinders on top of the roof slab, which while not absolutely water-tight will still hold a considerable quantity of water. In some cases holes have to be drilled through the ceiling to drain this slab. In one building water from this source dripped from the ceiling five months after the roof had been waterproofed. In another case there was some dripping even after two years.

* * *

325. Cinder Foundation in Sidewalk Construction

"We should be glad to hear from authoritative sources some expressions of opinion relative to comparative merits of concrete sidewalks with and without drainage foundation, using as a basis for comparison, a 4-in. thick slab of concrete laid on a cinder cushion 8" in thickness, or a 4-in. thick slab of concrete laid on a solid dirt bottom, without any cinders or other provision for drainage. Our own experience has been that the latter method is equally as good as the former, if not a shade better, other things being equal as to material and workmanship, but we should like some expressions from engineers and others in the trade as to which of the methods, if any, is either considered standard, or tending to become so.

"In this connection, we should like to know whether or not it is usual in the case of the cinder foundation being required, to demand that the cinders be passed through a ¼-in. screen, assuming that the cinders are a good grade of factory cinders, with the usual amount of fine material, but free from waste or rubbish. We have been in the habit of using the cinders as they come to us, but we are now asked to screen them through a ¼-in. screen, on the engineer's interpretation of the clause 'clean steam cinders' used in the specifications.

"Is the specification referred to not unusually strict, and arbitrary in general, and if required to be lived up to in its entirety, would it not make the cost of sidewalks laid in strict conformity with it a very expensive, not to say an almost prohibitive, job?

"We should be obliged for your opinion relative to the following terms from the sidewalk ordinance under which we are now working:

'clean steam cinders'
'clean, sharp, screened sand' (used in the concrete)
'covering and keeping moist for three days'

"We are trying to have a change made in the specifications which will allow of good work for less money than is entailed in laying the sidewalks strictly according to sample specification and your good advices, and those of correspondents will be appreciated."

325. Discussion by E. P. Etzel[*]

The opinions expressed in discussing the above question in recent issues of Concrete-Cement Age have been very interesting to us. They cover such a wide range, however, and the pros and cons are so evenly divided on the question that much may yet be said. As a basis for argument favoring the walk without any provision for drainage, I would like to ask the opposition why in laying modern concrete roads, sidewalk practice as regards drainage is disregarded by engineers and laymen, although there is not very much difference in the use to which both are put, and the thickness of the material varies only in relation to the use which both get.

If it is desirable to put a lot of loose and porous material under a sidewalk, why not under a modern concrete pavement? If the danger is from frost in the former, why not in the latter? We will admit that in both cases the soil on which the work is laid must be of suitable quality and well compacted, but why the ashes?

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[*] Engr. in Charge, Inf. Bur., Universal Portland Cement Co., Chicago

[*] Treas., F. W. Gibbs Contracting Co., Montclair, N. J.

* * *

333. Permanence of Concrete Silos

"In talking with a large stockman in this vicinity who is considering the construction of several silos, he has advanced the objection to concrete construction on the grounds that there is a chemical reaction between the concrete and ensilage which spoils the latter for a distance from the wall.

"He also states that he has heard that the acid in the ensilage has a deteriorating action on the concrete which will eventually cause the concrete to crumble. Can you give me any information in regard to this?"

333. Discussion by John H. McCoy*

The above quotation is the argument used by the wood stave silo men, and some others who have an "axe to grind." But the statements made are absolutely without any foundation in fact, although most people when they hear such statements advanced, fail to take into account the source from which they come. If it were possible for all men to be open to conviction of the truth, and to have the truth regarding this matter as set forth by a host of men who have no interests to serve, but to state the facts as they find them and without fear of successful contradiction, there would be no difficulty.

If this inquirer and the host of others like him could see their way to accept the findings of our U. S. Dept. of Agric., Bur. of Animal Industry, as the truth, without bias, it would at once and for all time put the monolithic concrete silo, considering its usefulness from every angle, in its proper position as the best possible to produce for the purpose.

This great truth must in the nature of things become universally accepted in the near future. In the natural order of things, the fellow with some other idea of a silo will become a back number. This is especially true, since it is now possible for the farmer himself or through some local contractor, to build or to have built the best possible silo, at a cost of possibly not much in excess of one of the temporary or make-shift sort.

The recommendation of the Bur. of Animal Industry, regarding the monolithic concrete silo, is worthy to be accepted, because their judgment is in line with that of the Dept. of Dairy Husbandry, of several of our most advanced commonwealths along those lines, and hundreds of satisfied users of this type of silo.

The evidence[1] of such men as Joseph E. Wing and C. J. McCombs should have great weight with those who seek for the truth, because Mr. Wing is, above all things else, a farmer and of very advanced ideas. He is not only that, but is also one of our foremost writers, lecturers and teachers of facts and things as they are.

As to Mr. McCombs, previous to his present position under the direction of the Univ. of Chicago, he was for seven years instructor of Dairy Husbandry at Madison, Wis., the Wisconsin State Agric. College. His judgment necessarily must be approximately correct.

For the benefit of Mr. McCombs and your other interested readers, it would be well that I make this statement regarding their second silo[2] on Buffalo Creek Farm. It was the pleasure of the writer to contract for and build both silos mentioned by Mr. McCombs.

At that time I had yet something to learn regarding the selection of materials, mixing and placing of concrete. In the second silo I used lake gravel for the coarser aggregates, and used a 1:2½:5 mixture proportioned by bulk. Regarding the same out of my years of experience, I can understand exactly what mistakes were made in that work. We were not, as Mr. McCombs assumes, saving of the cement, because identically the same mixture was used in both silos, except that in the later silo we used lake gravel, as previously stated, instead of crushed rock as in the first silo. We also used a much sloppier mixture, that is, it had more water mixed with it and the concrete was well spaded and puddled in the forms; in fact, too much so, as we have learned that it is entirely possible, during the initial setting process of concrete, when it is combined with too much water to have a percentage of free sand carried by the water to the outer extremities of the wall.

I am positive that the juices of the ensilage are not having an injurious effect on the concrete, and am also positive that it is an exceedingly good silo, because it is used for summer feeding only, and there is no spoiled ensilage.

It is of utmost importance that the builders of concrete should learn that the materials, sand, stone and cement, be they never so well proportioned, must also have a proper proportion of water; not too much and not too little, but enough to secure the ideal quaking mass just inclined to flow.

The Economy of the Concrete Silo

When it becomes generally known that the concrete silo is absolutely right, and that it is the best investment for the purpose, even though it should cost much more than one of the less permanent varieties, and also when it becomes generally known that there are forms on the market which may be purchased and used by the builder at an expense for each silo not to exceed $25 to $50, depending on the size of the structure, and too, when builders understand the philosophy of the proper selection and grading of materials and will properly mix and place the same, when this time comes, the monolithic reinforced concrete silo will be practically the only one.

Its Future

From the showing our business has made the present year, I incline to turn prophet and prophesy that inside of 10 years all those now important discussions as to the *pros* and *cons* of the concrete silos will then seem to us to have been trivial, because this silo must become supreme, for we as a people are thinkers, and the truth is mighty and must prevail.

* * *

337. Silicate of Soda Paint

"Some time ago the following formula was given to us to make a paint for concrete work, claiming that it could be washed and scrubbed:

Silicate of Soda—N grade....1 gal.
Oxide of zinc ground in water..1 lb.
Flour marble enough to make the whole to the consistency of paint.

We have followed the directions and it gives a beautiful white, but it comes off and peels. We then reduced the silicate to about 20° Beaume and it does not entirely come off. When you rub it with the finger, once dried, some powder comes off.

Will you please tell me the cause of that trouble and the remedy?

If you know of any work on silicate of soda paints for concrete, will you please advise me the name of the work, that of the firm who sells it, and if possible, the price?"

337. Discussion by R. A. Plumb*

In regard to formula for artificial marble on which these experiments have been conducted, the cracks developed in preparing larger slabs are undoubtedly due to shrinkage, and it is possible that their occurrence can be somewhat relieved by keeping the specimens damp, so that the drying and hardening will proceed somewhat more slowly.

In the above formula, of course, the only water introduced is what occurs with the sodium silicate, and this would hardly be sufficient to provide for the normal hydration of the quantity of white Portland cement which is used. The sodium silicate would naturally react partially with the oxide of zinc, forming a silicate of zinc and releasing the sodium, undoubtedly in the form of a hydroxide.

While the largest percentage of the mixture employed is of a fixitive nature, yet it would be evident that the compounds which are formed in the interreactions are characterized by a large shrinkage factor, and in the evaporation of the water that is added through the sodium silicate this results in contraction and shrinkage, forming cracks.

We would not anticipate that this artificial marble would have any practical application on exterior exposure, as there would be sufficiently soluble content to result in gradual solution and ultimate disintegration.

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*Pres. [illegible]

[1] This refers to discussions of this question by Joseph E. Wing, [illegible] anicsburg, O., Prof. J. B. Davidson, Agric. Engrg., Iowa State College, Ames, Ia., p. 118, Sept., 1913, issue, and Helmer Rabild, in charge Dairy Farming Investigations, U. S. Dept. of Agric., Bur. of Animal Industry, Washington, D. C.

[2] This refers to the second silo described in the discussion by C. J. McCombs, Supt. Buffalo Creek Farm, Arlington Heights, Ill., on p. 175 of the Oct., 1913, issue

*Gen. Dir. Trus-Con Laboratories, Detroit

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339. The Use of Lampblack in Concrete

"Does the use of a small amount of lampblack to darken concrete, weaken it at all?"

339. Editorial Discussion

In a report made recently to the Assn. of Am. Portland Cement Manfrs. by the Inst. of Industrial Research, Allerton S. Cushman, Dir., a table presents some data on what effect carbon blacks have on the strength of concrete. The table follows:

Containing Carbon Black (Lampblack)

	Lbs. per sq. in.	
a. Carbon Black 2%		
Neat Briquettes:	Air	Water
7 das.	488	535
28 das.	592	763
Mortar Briquettes (1 lime: 10 cem. 20 sand)		
7 das.	409	368
28 das.	390	497
b. Carbon Black 5%		
Neat Briquettes:	Air	Water
7 das.	440	617
28 das.	503	747
Mortar Briquettes (1 lime: 10 cem. 20 sand)		
7 das.	230	308
28 das.	248	385

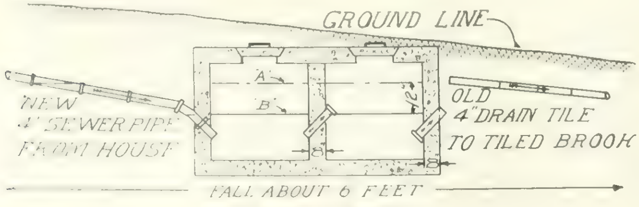
* * *

341. Septic Tank Outlet

"I have just completed a septic tank, the chambers being 4' x 4' x 4' inside, and having a 4-in. sewer pipe siphon connections. The tank is not vented, the action being entirely anaerobic. The owner wished to use an existing drain for the discharge from the tank, but after the tank was finished it was discovered that the drain was 12" higher than the tank outlet. To save the expense of digging up the tile he desires to raise the level of the liquid in the tank 1' to dotted line shown in sketch. This will back up the water in pipe above the tank for several pipe lengths. None of the bathroom fixtures are vented. Is this plan permissible?"

341. Discussion by F. M. White*

I would not advise using the septic tank exactly as illustrated in the drawing. In order that the septic tank may give perfect satisfaction, some device must be arranged which will entirely prevent any entering current of sewage which would destroy the purifying bacteria. Raising the level of the water to line "A" would not in itself be dangerous or detrimental to the temporary success of the tank. There would be considerable danger of the 4-in. sewer pipes from the house plugging up, and also a scum forming on the surface of the water in the tile, which would be broken intermittently and as a result the anerobic action destroyed. If the inlet could be changed as shown at "C," this tank should prove satisfactory. The outlet "D" of tank No. II should be placed with the top line a trifle below the level of inlet pipe "C."



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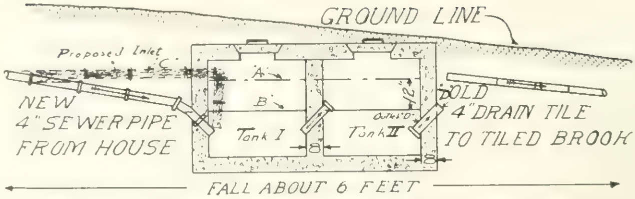

Fig. 2. Sectional Sketch Showing Arrangement of Septic Tank and Drain Tile

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345. Chimney Construction in Monolithic Cottages

"I am planning to build several poured concrete houses and want to know the best way of building concrete chimneys. What advice can you give me?"

345. Discussion by Wm. Mayo Venable*

Regarding the best way of constructing concrete chimneys in concrete residences, in our opinion the best way and in fact the only way we would consider on work for which we are responsible, is merely to build ordinary flue linings in the concrete pilaster or column. In other words, the flue linings are inserted in place and the concrete is poured around them in ordinary wall forms of any of the usual types. The construction of chimneys of larger size is, of course, an entirely different matter and much more complicated methods must be employed in this work.

Although concrete will stand a considerable degree of heat, it is not advisable merely to build flues in concrete walls without the fire clay lining, as this would expose the concrete to great and immediate variation in temperature and would be likely to cause more or less cracking or discoloration of the wall. Moreover, the placing of vitrified clay linings is about as cheap as it would be to place the simplest kind of core and to remove the same.

354. Building a Cemetery Wall

"I want to build a concrete wall around a cemetery 128' deep and 162' wide. I want to build a good, solid wall, one that will stand. What advice can you give me?"

354. Discussion by Ed. D. Boyer*

From the information we have at hand we are not exactly certain whether it is desired to build a concrete wall or a concrete fence, and not being familiar with the conditions, we cannot say which would best answer the purpose. A concrete fence, however, could be built in a very economical manner and the cost of construction would be considerably less than for a concrete wall.

A Concrete Wall

Our suggestion would be to build a concrete wall about as shown in Fig. 1. In building a concrete wall it is necessary to have good foundations and these should extend down 3' below the surface of the ground. Concrete foundations 3' deep and 18" thick would answer the purpose. If there is danger of unequal settlement it would be advisable to block off the foundation and wall into short sections. White Portland cement with white silica sand or marble dust gives a very pleasing finish. As an estimate, there will be needed 1.4 bbls. cement for a 10-ft. length of wall, using 1:2½:5 mix. A suggested detail is shown in Fig. 1.

A Concrete Fence

In building a fence, we would suggest the use of posts 7' long, 4" x 5" at the top and 5" x 6" at the bottom. These should be placed 10' o. c., allowing 4' above ground.

For the fence proper we would suggest the use of metal lath 28-ga. and a small strip of metal lath to run horizontally along the top to form the railing. It would be advisable to have the lath run continuously and this, of course, would necessitate the casting of at least the upper part of the post in place. By the use of metal lath, forms are avoided, as the mortar can be plastered directly onto the lath in two coats, making a total thickness of approximately 2 in. We would suggest the use of mortar made of 1 part of cement and 2 parts sand.

As to the amounts of cement needed, 14 posts of a 1:2:4 mixture can be made of 1 bbl. cement, and there will be

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*[illegible] Agr. Engrg., Univ. of Wis., Madison, Wis.

*Engr. Bldg. Dept., Blaw Steel Const. Co., Pittsburgh

*Atlas Portland Cement Co., N. Y. C.

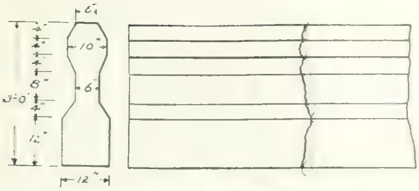

Fig. 1—Suggested Detail for a Wall

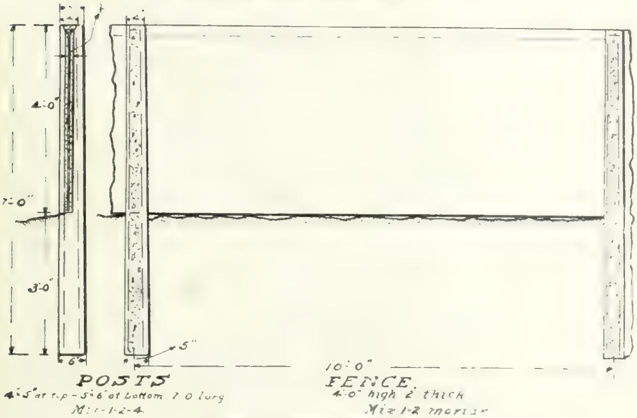

Fig. 2—A Concrete Fence Detail

needed about 0.9 bbls. cement per 10-ft. length for the fence, using a 1:2 mortar. The plan, of course, allows of considerable variation, i. e., the fence could be made of either less or greater height and a different railing could be easily molded; also, it could be blocked off in squares or panels if so desired.

356. Expansion Cracks in Reservoir Construction

"The accompanying sketch shows a reservoir which we have now in plan. We want to know what would be the best scheme of taking care of expansion and contraction in the walls and floor. Practically all of the walls and floor will be underground after completion, but we do not want to take any chances on having cracks develop."

356. Discussion by Francis W. Wilson*

To arrive at a really economical and efficient design for such a reservoir, the problem should be carefully studied and a complete design prepared. The following notes are merely outlined suggestions, as it were, which may help to make for a better structure.

In a reservoir of these modest dimensions it is not necessary to apprehend much trouble from expansion and contraction, but that does not mean that there will be no trouble from the cracking of the concrete. Any concrete structure, no matter how small, is likely to crack if not sufficiently reinforced with steel, but these cracks can hardly be attributed to expansion and contraction as generally understood. In other words "expansion joints" as frequently made would not prevent them. They are more due to internal stresses in the concrete than to the expansion of the concrete structure as a whole.

I would recommend the following:

(a) Use smaller sizes of reinforcing bars and more of them. That is, space them closer together both horizontally and vertically. There are some kinds of steel mesh which would be well adapted to this purpose. Use a type that will resist the stresses along straight lines in both directions,—that is, horizontally and vertically.

(b) In trying to make a watertight structure, do not use a concrete mix as

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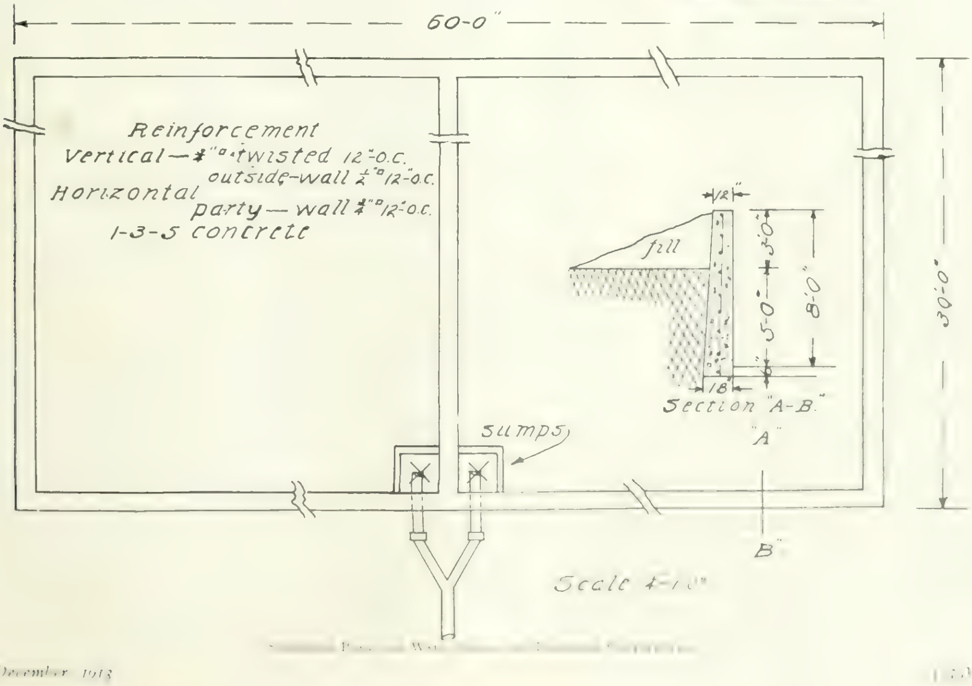
*Cons. Engr., Hanover, Mass.



[illegible] Plan and Wall [illegible]

weak as this sketch shows—1:3:5. A 1:2:4 mix will be denser,—the other is too porous, or likely to be, even if the voids appear to be well filled.

(c) Section *A-B* does not show the kind of a detail that can easily be made and kept waterproof. An experienced designer would hardly care to take chances on the results if this detail were used.

(d) Use a good standard waterproofing compound in all the concrete, for both floor and walls.

(e) A complete lining of plastic slate would go far to overcome the effect of small cracks if they did occur, since the water pressure is from the inside in this case.

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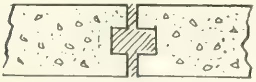
356. Discussion by A. V. Spinosa*

For a reservoir such as the one shown, 8′ x 30′ x 60′, we are of the opinion that no expansion joint is necessary, provided sufficient steel be added to take care of the temperature stresses. Using a co-efficient of expansion of 0.0000055 for concrete, and assuming the commonly used total temperature change of 50° F., a total contraction of 3/16″ would result along the 60-ft. dimension of the reservoir with a change of 3/32″ in the 30-ft. dimension. According to the best authorities, this should easily be taken care of by the horizontal steel which is now provided, according to the sketch.

If it is deemed advisable, however, to use expansion joints, a 6-in. keyway may be provided for in the long dimension of the reservoir and this keyway rammed with plastic clay mixed with grass roots and loam. The following sketch will give an idea of such a keyway



A Keyway Joint Used

We know of an instance in which this type of joint was most satisfactory. A certain reservoir was built of plain unreinforced concrete with a vertical outer facing and a sloping inside facing. The concrete wall was built in alternate sections, not exceeding 50′ in length. The vertical keyways 6″ square, one-half of which was in each section as shown in the sketch, were built for expansion joints and first filled with asphalt. This asphalt cracked in cold weather, causing leakage, and it was removed and replaced with plastic clay. The clay showed a tendency to ooze out and allow small leakages. Next a mixture of plastic clay, grass roots and loam was tried, which up to the present time has proved satisfactory.

We suggest for this floor construction concrete blocks 8′ x 8′ and 4″ in thickness, all joints to be well filled with asphalt and the whole covered with 2″ of 1:2 mortar.

356. Discussion by R. D. Snodgrass*

In a structure the size shown on the accompanying sketch the question of expansion and contraction in the walls is not a serious one. We note on this sketch that reinforcing steel is shown running both vertically and horizontally in the walls and believe that this is all that will be found necessary. We would suggest, however, that the splices in the horizontal steel be made of sufficient length so that there will be no question in regard to the transfer of stress from one bar to the other, providing temperature stresses should occur.

We note that the walls and floor are both below ground, for which reason the likelihood of expansion cracks is very much reduced. These cracks usually occur in walls which are subjected to a wide range of temperature or to concrete roof construction where in winter one side of the slab is exposed to a very much higher temperature than the outside, which is exposed to the air. It is usually sufficient to use a quantity of reinforcing steel for expansion equal to 0.5% of the cross-section of the concrete. We note that the suggested design does not contain this quantity of reinforcement, but, since the temperature variation is sure to be small it does not seem to us that any more will be required than shown. We might suggest, however, that the bottom slab be reinforced in this reservoir with ⅜-in. bars spaced in both directions about 18″ c. to c. This will prevent cracks which might occur on account of unequal bearing conditions of the soil.

* * *

358. White Surface for Burial Vaults

In finishing the inside of concrete burial vaults, I want to make the surface as clear and spotless a white as possible. What materials or wash should I use for this purpose?"

358. Discussion by C. W. Boynton†

To secure a white finish on concrete burial vaults, the inside can be covered with a plaster coat of white cement and white silica sand, after the forms have been removed, mixing this plaster in the proportions of 1 part white cement to 1½ parts of silica sand.

Another method would be to use some form of concrete paint or coating, of which there are a number now on the market.

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358. Discussion by Albert Moyer‡

The use of white Portland cement and pure white marble screenings is suggested, all passing through a ¼-in. mesh and not containing over 30% of dust which will pass a No. 50 screen or 10% of dust which will pass a No. 100 screen; mix in proportions of 1 part white Portland cement, 2 parts marble screenings.

After these screenings have been plastered on the wall by use of metal lath, keep them damp for at least a week, when the concrete will become thoroughly hard. Make up a concrete brick, about the size of an ordinary common brick, the brick to be composed of the same materials as the wall, allow same to harden thoroughly, and with the flat surface of this brick scrub the wall, using clean water, working this brick over the surface evenly and scrubbing same thoroughly. Do not wash off the wall after same has been scrubbed, but allow it to dry. If there are uneven patches where the wall has not been thoroughly scrubbed, they will be noted after the wall is dry, and can be scrubbed in that particular spot. This will produce an absolutely pure white surface, which will remain white unless, of course, it becomes stained by soot or dirt.

In this connection, it seems strange, but it is a fact that ordinary gray Portland cement, if treated in this manner, using a brick made of gray Portland cement and sand, will be very materially lightened so as in the sunlight to look almost white.

The concrete telegraph poles along the line of the P. R. R., from the Bergen Hill cut to Manhattan Transfer across the Hackensack Meadows, N. J., were treated in this manner. They are made of gray Portland cement, have been in place for a couple of years, and on a dry day have the appearance of being white.

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358. Discussion by Benjamin A. Howes*

In the first place the inside should be smooth, a condition that is usually obtained by having a smooth form slightly oiled. The oiling should be as slight as possible in order that the surface of the concrete be not disintegrated or stained.

For a very cheap coat, I should recommend the Government Lighthouse Whitewash, as published in your columns.[1] For a tough and somewhat elastic coating, I have used under similar conditions, Bay State Brick and Cement Coating.[2] This appears to be in the nature of enamel paint, which is limeproof, and would probably cost for labor and material put on, from 3 cts. to 5 cts. per sq. ft. of surface. There are other similar paints, which I believe are equally good, although I have not used them.

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*[illegible] Metal Co., Braddock, Pa.

*Chf. Engr., Trussed Concrete Steel Co., Detroit

†Insp. Engr., Universal Portland Cement Co., Chicago

‡Vulcanite Portland Cement Co., N. Y. C.

*Engr. and Contr., N. Y. C.

[1] May, 1913, issue, p. 239

[2] Wadsworth, Howland & Co., Boston

358. Editorial Discussion

In the Mar., 1913, issue, p. 116, was discussed a reinforced concrete fence built by the Carnegie Steel Co., at New Castle, Pa., which was finished up with a wash of lye, alum, cement and water, in order to get a white surface. We now have from John S. Oursler, gen. supt., Carnegie Steel Co., under whose direction the work was done, information for making this wash. It is made up as follows:

1 lb. Concentrated Lye
4 lbs. Alum
5 gals. Water

To this was added sufficient cement to make a wash that would spread nicely with a large brush.

* * *

359. Concrete for Stable Floors

"A proposed Health Board regulation for the City of Hartford, Conn., is objected to by numerous owners of fine horses because the regulation specifies concrete floors. While the ordinance is favored by numerous organizations, the stable owners themselves appear to object on the ground that the concrete floors are injurious to horses. Is their objection well taken?"

359. Discussion by Arthur Ware*

When I built the stable[1] for Mrs. Harry S. Bowen at Round Hill, Conn., this question was gone into very seriously, as all of Mrs. Bowen's horses were thoroughbred show horses and represented a large sum of money. Her head coachman, second coachman, and all her stable force were Englishmen who were thoroughly familiar with the handling and training of thoroughbred horses. There was no objection made to having the concrete for the run-ways, the carriage room floors, wash room floors, harness room floors, etc., etc., but no concrete was used for the floors of the box stalls or the standing stalls. The floors of the box stalls were simply compacted clay upon which the straw bedding was laid. The floors of the standing stalls were heavy slatted wood floors placed on top of cast iron pans. It is very injurious to the horses' hoofs to have them stand on concrete, as they stamp and it makes them lame and their feet sore. Concrete or brick should not be used in the actual stall itself, but it is thoroughly practical for all other places. Where used for run-ways it should be given a hard granolithic finish, which makes it practically non-absorbent.

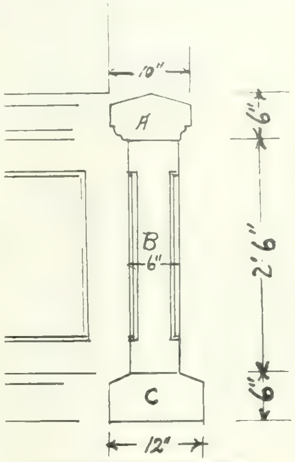
* * *

360. Measuring Concrete

"We have just completed the construction of a concrete balustrade and rail for the City of New York. We are paid for this work on the unit basis, that is, by the cubic yard, and we calculated our quantities by taking the outside dimensions. In section the balustrade is 36" high, 12" wide at the base and at the top, with varying dimensions from 5" to 7" through the panel. We took dimensions 12" x 36" to determine the quantity, while the city engineers figure the actual quantity of material only. The engineers admit that to furnish a 5-in. section costs as much as a 12-in. section and they frankly admit that if the balustrade were of stone, the outside dimension of 12" would govern, but in the absence of any authority, ruling or custom in the matter, they are not prepared to allow our claim. We should like to know what the custom is in figuring such work."

360. Discussion by H. E. Rackle*

As to the general custom in estimating concrete quantities for balustrades, we have estimated a great many balustrades in past years but have never found any engineers who would allow anything but actual contents for work of this character. Referring for instance to the accompanying sketch, we would figure the work as follows:



Section View of Balustrade

Member "A" would be figured 6" x 10" square, making no allowance for cutting away corners.
Member "B" would be figured 2' 6" x 6" square, sunken panels not excluded.
Member "C" would be figured 6" x 12" square.

It can readily be seen that this is the only practical and sensible way of estimating this work, as you see member "C" might work out to double widths as shown on sketch. Member "A" would work out to a great deal more in width, while member "B" would still remain as shown. In accordance with that way of estimating there would be no way of determining the contents and amount of material needed to perform the work.

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360. Discussion by J. M. V[illegible]†

In figuring a job of this nature, it is our custom to take the quantities off in the manner in which the material would be furnished, namely: in three sections consisting in this case of base, panel and rail, using outside dimensions for each particular portion. This would give a result very close to the actual quantity of material to be furnished, which is all we could consistently expect to be paid for. Our material, however, is decidedly different from ordinary concrete built in place and the methods of computing quantities which would govern its use in units might be entirely unfair and not at all applicable in the use of concrete cast in place. We have heard of cut stone being either figured or sold by the cu. yd., where the design was as elaborate as a balustrade and cannot see why the fact that the outside dimension would govern in cut stone work serves as any criterion by which to figure concrete. If the stone man were paid on a basis of outside dimensions it would be because it was necessary for him to use that quantity of stone to furnish the job; this argument does not apply in the case of concrete. Your inquirer is undoubtedly correct in stating that it costs fully as much to furnish a 5-in. section as a 12-in. section and it appears to us that it is a matter which should have been taken care of in submitting his bid and that he cannot consistently expect to be paid for material which he did not furnish.

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360. Editorial Discussion

Attention is also called to the report of the Committee on Measuring Concrete of the N. A. C. U., as adopted Dec. 14, 1912, which recommends in Sec. 4 that the custom of the cut stone trade be followed for ornamental work, that is, in measing the smallest rectangular solid out of which the piece can be cut, instead of measuring the volume of the finished work.

Water Power Development on the Skagit River

The Secretary of Agriculture has just granted to the Skagit Power Co. a permit for the development of two water power sites on the Skagit and Cascade rivers in Skagit county, Wn., within the Washington national forest.

It is stated by officials of the company that construction work on the Skagit project will be begun within a comparatively short time. The construction will consist of a concrete diverting dam 50' in height, a tunnel conduit about 3.7 miles in length, and a power house on the Skagit river about 125 miles from Seattle, at which most of the power output will be marketed. In developing power from the Cascade river, the flow will be diverted by a concrete dam having a height of 20' and a maximum length of about 200'. A flume and tunnel will carry the water a distance of approximately six miles to the proposed power house.

Machinery capable of generating over 50,000 h. p. will be installed at the two power houses, according to the estimates of the engineers.

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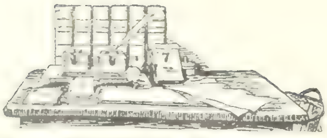
*Architect, N. Y. C.

[1] See p. 181, Oct., 1913

*Geo. Rackle & Sons Co., Cleveland

†Onondaga Litholite Co., Syracuse, N. Y.



Correspondence

The Permanence of Concrete Silos

We have studied carefully an article entitled "The Silo—How to Make It Permanent," which appeared in a recent issue of *Brick and Clay Record.*

Speaking concretely, if we had not had years of concrete experience,—if we had not written, endorsed and published many, many statements in emphatic contradiction to that author's—if we had not virtually "lived" our arguments and recorded findings,—well might we feel ill at ease—even for the safety of our lives. Well might all of us ponder on the chaotic conditions when this non-substantial material yields, as our worthy critic prophesies, and our Croton Dam, Panama Canal and Los Angeles Aqueduct confirm his opinion as to the "friability of concrete." This is not dealing in futurities, either, for concrete has that qualification of showing its "yellow streak" at once or never. If it's "yellow" through and through, as some predict, let us prepare immediately for the worst.

To be more specific in reference, the author, in the article to which we are taking exception, qualifies concrete as a material with a "tendency to crumble," unfavorably "affected by frost" and even in its field "non-permanent," and adds that a "more substantial" material could be used. It is deplorable that America's engineers did not know this some time ago.

Now, let us assume that "concrete" has been qualified properly above, allowing even the most literal definition of "non-permanent,"—will the everlasting burned clay silos be the only structures intact when the final plunge comes, if they are supported on a foundation of this same "concrete"—if the lower and supporting 4-ft. of them is this same "concrete"? If we are to follow the design set out by our critic, we are to use burned clay and we are to use this "concrete" for the foundation,—for the lower 4′ as called for by the advocates of terra-cotta silos. If a "more substantial" material could be used, why not use it under an everlasting structure?

What has more work to do—what has more strain to withstand,—what has more to endure—than the foundation of a silo, drawing the comparison from a complete silo? Why we must accept burned clay as the perfect material and use a condemned material in the place subjected to the most rigid tests, is argument we cannot fathom.

In a silo, are not ensilage juices most prevalent in the lowest 4 ft.? Would not porosity encourage more activity in the lower 4 ft. and foundation than in any other part of a silo? We believe that one should remember that a chain is no stronger than its weakest link, and that it is poor economy to build a stone house on a wood foundation.

We cannot, Mr. Editor, accept this verdict against concrete. We must still remain in the minority, if our critic chooses, because we know and believe in "concrete." We know from experience that concrete is permanent. Although the simile that the "everlastingness" of concrete is today in competition with Gibraltar is not ours, yet our observation forces us to accept that conclusion. We know ensilage juice won't affect it unfavorably—we know that it is not porous if properly made. We agree that it is the best material on which to construct everlasting structures and burned clay structures, too, and know it is just as good to use it on up to the top, because experience has taught us as much and our endorsement is infinitesimal in comparison with that of the engineering world.

We have tried to picture concrete in the aspect one would gain from the context of the article cited, but our imagination is not strong enough—our vision is blurred by many tumbling burned clay silos that some unthoughtful engineer had erected on "concrete" foundations. If our imaginative powers are to be developed to that point where we can see as our critic sees, we shall have to place our "New 1913 Model Webster's Unabridged" on a concrete pedestal and see it sink from view first, that we may forget what "consistency" ever did mean.

We believe that a good monolithic concrete silo, from all points considered, is without a single exception, the best silo that can be built.

H. T. G[illegible]*

* * *

Concrete on Kenwood Road, Oneida, N. Y.

The Kenwood road is in the town of Oneida, Madison county, N. Y. The town of Oneida is divided into two districts known as the inside district and the outside district, the inside district being inside the corporation limits of the city of Oneida. But both districts are under the jurisdiction of the Board of Public Works and its superintendent. The Kenwood road came under the supervision of the Supt. of the Board of Public Works.

The plans and specifications for this piece of concrete road were prepared by the County Supt. of Highways and approved by the State Highway Commission. I was engineer in charge of the construction for the City of Oneida. The work was done under contract by Nixdorf & Desenzo, Oneida, N. Y., their lump sum bid being $3,465.

The grading was started Sept. 2, and completed Sept. 23; began laying concrete Sept. 24 and finished concreting Oct. 21. Then the surface of pavement was covered with a coating of Tarvia "A"[1] and sand, which was completed Oct. 31. The road was then opened to traffic about 5 o'clock Oct. 31, which was 10 days after the last piece of concrete had been placed before any traffic was turned on it. The concrete was kept wet down, after being laid, for nine days.

The length of concrete road constructed is 1,350′, 14′ wide, 6″ thick, one-course, with 3-in. crown. The material used is stone, sand and Portland cement, the size of stone being 2-in. and ¾-in. mixed. The proportions were 1 part of Portland cement, 2 parts of sand and 4 parts of broken stone. Whitehall[2] cement was used throughout the work.

The concrete was all mixed by hand and made just wet enough to make it plastic. The sub-base was wet down before the concrete was placed on it, then the concrete was well rammed and the surface struck off with a template which was made to conform with the crown.

There were no expansion joints placed in the work. When stopping work at any time there was a vertical stop timber placed at right angles to the road and the work completed up to its full section up to and against this timber.

Before the wearing surface was put on the surface of the whole pavement was thoroughly cleaned, and after the surface became dry there was spread over it a coating of Tarvia "A," 4/10 gals. to the sq. yd. of surface. This was applied at a temperature of about 230°. Immediately after the bitumen had been spread it was covered over uniformly with a ⅜-in. layer of clean, sharp sand. After the wearing surface was completed the road was kept closed to traffic for five hours. I expect to keep a close watch on this piece of concrete road for some time and note its behavior, as it is located in a vicinity where there is very heavy traffic. We may build some concrete pavements in Oneida next year, in the residential districts.

J. M. Hutton

Civil Engineer,
Oneida, N. Y.

Contemporaneous with the great and worldwide growth of the cement industry comes the broadening field of discussion of all that pertains to cement, its manufacture and use. An interesting development in this connection is the widespread discussion of cement matters among Italian engineers and chemists. Recent papers in the Italian scientific publications relate to the study of puzzolan and old Roman mortars and to the gelatinous calcium sulphate and the setting of gypsum, to say nothing of numerous comments upon reinforcement and the manufacture of concrete. The revival of scientific interest in cement and its uses in the original home of cements and cement mortars, in times gone by is a mark of the present developing period in the industry.

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*[illegible] P. B. Co., [illegible], Ind.

[1] Barrett Mfg. Co., N. Y. C.

[2] Whitehall Portland Cement Co., Philadelphia

NEW BOOKS

An Analytical Study of Excavating Machinery*

During the last decade, the author has been interested in the method and cost of operation of the various kinds of machinery used for excavating. As a practicing civil engineer, his experience has brought him into close touch with excavators used in tunnel and subway construction, irrigation, drainage and water power developments, road and railroad construction, and municipal improvements. As far as practicable, he has kept notes of his observations of the efficiency and cost of operation of machines and has occasionally made a study of the details of design of some of the better known types. These notes were compiled a few years ago for classroom use and recently elaborated by a study of existing records and authorities, into the present work.

Scrapers

The book opens with a discussion of drag and wheel scrapers, which are well known and highly efficient tools for shallow excavations, and small embankments. The cement manufacturer and concrete engineer use these excavators to advantage in stripping soil from banks and pits of shale, gravel and sand, the removal of the loose material for short hauls and the excavation of shallow pits. Scraping and elevating graders are described and cases are cited of the use of the various forms of graders in road construction, the excavation of small drainage ditches and large irrigation canals, the construction of embankments and earth dams, etc.

Steam Shovels

The chapter on steam shovels gives a detailed description of the various classes of this type of excavator. Cement manufacturers use the steam shovel very generally in the excavation of the raw materials used in making natural and Portland cements. The large contractor and materials supply men use the machine for the removal of sand, gravel and stone from pit and bank. Where the job is of sufficient size to warrant its use, and the soil is firm and hard enough to support it, the steam shovel is a very efficient and economical type of excavator.

Drag Line Excavators

The best known and most generally used type of dry-land excavator is the drag-line or scraper-bucket machine. A few years ago this type of excavator

A Drag Line Excavator in Operation

was used principally for the construction of drainage ditches, but recently with the increase in capacities and power and the use of caterpillar tractors, its field of work has been widely extended to include railroad construction, foundation excavations for dams, buildings and other structures, earth and rock excavation in surface mines, quarries, cement plants, sand and gravel pits, etc. A drag-line excavator in operation is shown in the accompanying illustration.

The Templet Excavator

An interesting form of ditch and canal excavator is the templet excavator. This machine has a bucket which moves transversely across the ditch, over a steel frame and gradually excavates the section with true and smooth side slopes and grades. This type of excavator is the best to use when the soil is firm and easily workable and the land free from trees, stumps and large stones.

The tower excavator is a type of drag-line scraper, which derives its name from its movable tower resting on a platform car. It has been successfully used for hauls under 300′ in the construction of dikes and the excavation of lock sites and canal sections on the Chicago Drainage Canal and the N. Y. State Barge Canal. On account of the small initial cost and low maintenance cost of this excavator, it could be economically used in making large shallow excavations, such as irrigation and drainage canals, sand and gravel pits, etc. Figure 3 shows one of the single tower excavators at work.

Floating Excavators

The floating dipper dredge is a truly American excavator which has been brought to a high degree of development in the reclamation of swamp and marsh lands and the excavation of channels in harbors, lakes and rivers.

Ladder Dredges

The ladder dredge is a European type of excavator, which was largely used by the French on the Suez and the Panama Canal and is still used extensively in Europe on harbor and canal excavations. This machine is efficient in the removal of all classes of materials in channels of sufficient width to allow the dredge to breast from side to side.

Trench Excavators

Trench excavators are divided into two general classes, viz.: sewer and water pipe trench excavators, and drainage tile trench excavators. Under the former class are the following five types: the traveling derrick or locomotive crane; the continuous bucket excavator, the trestle cable excavator, the tower cableway and the trestle track excavator.

There are several well-known makes of the continuous bucket excavator, which is built on the principle of the continuous excavator or ladder dredge and is used for the excavation of trenches with vertical sides.

Cableway Excavators

The tower cableway excavator is a hoisting and conveying device, using a suspended wire cable as a trackway. This type was early developed in the stone quarries in the eastern section of this country and has proved to be very efficient in raising large masses of rock to a considerable height and their transportation over long spans. In recent years these cableways have been successfully operated in the excavation of dam and bridge foundations, the conveyance of structural materials across rivers, stripping coal mines and quarries, hauling logs, etc. This type of excavator is especially efficient when used in co-ordination with steam shovel or drag-line excavator, for the purpose of conveying excavated material from a large and deep excavation to the points of disposal at higher elevations.

It is instructive to study the use of various types of machinery on the same job. After a comparative view of the operation of various machines one is convinced that it is clearly impossible to lay down any rules or state any formulas by means of which an excavator can be arbitrarily selected for any proposed work. There are always so many variable conditions and unknown and unforeseen factors to consider, that it is to a great extent a matter of judgment. This essential, but rare quality, is born in some people, but, by most of us must be acquired by experience.

* * *

Proceedings of The Ninth Annual Convention of the American Road Builders' Association; 6″ x 9″; paper [illegible] American Road Builders' Association, 150 Nassau St., N. Y. C.

The title gives an adequate idea of the large amount of information to be found in the work

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*A review [illegible] "Excavating Machinery." By Allen [illegible] M. Am. Soc., C. E., Asst. Prof. of Civ. Engrg., Univ. of Ill.; McGraw-Hill Book Co., N. Y. C. [illegible] $3, net.

Concrete Roads and Pavements. E S. Hanson; 228 pages; illustrated; cloth bound; size 5" x 7¾". Cement Era Publishing Co., Chicago.

In this volume the author has collected many valuable data on concrete paving work. The subjects covered are best indicated by titles of the 13 chapters which are as follows: Concrete as a Road Material; The Construction of Concrete Roadways; The Roads of Wayne County, Michigan; Cost of Concrete Roads in Illinois; Other Examples of Concrete Roads; Some Data on City Pavements; Reinforced Concrete Pavements; Concrete in Combination with Other Materials; Patented Concrete Pavements; The Theory and Practice of Joints; Some Tests on Concrete as a Roadway Material; Bridges and Culverts; Sidewalks, Curbs and Gutters. Appendices A to L give the specifications of The National Concrete Institute; Wayne County, Mich., Mason City, Ia., Illinois Highway Commission for concrete paving; two types of Blome patent paving, Bitustone, Dolarway, Hassamite and for Bridges and Culverts, Sidewalks and Curbs and Gutters.

Architects' Directory and Specification Index. Tenth Edition. 10" x 7" 204 pp. Cloth binding. Price $3.00. The William T. Comstock Co., 23 Warren St., N. Y. C.

A new edition of valuable reference work with which our readers must already be familiar.

Licensed Contractors in Boston

A statute recently enacted in Boston requires that all individuals engaged in construction work—that is, those taking charge or responsible control, shall have a license. There are five classes of registration differentiating control of construction work, as follows:

(a) Charge or control of the construction or alteration of first class buildings.
(b) Charge or control of the construction or alteration of second class buildings.
(c) Charge or control of the construction or alteration of third class buildings.
(d) Charge or control of the moving or shoring of buildings or structures.
(e) Charge or control of the tearing down of buildings or structures.

Section I of the ordinance is as follows:

"All persons who shall hereafter take personal charge or control of the work of construction, alteration, removal or tearing down of buildings or structures in the City of Boston shall be qualified by education, training, or experience for the performance of that duty in a manner which shall preserve public safety and conform to the laws, ordinances, rules and regulations relating to the construction, alteration, removal or tearing down of buildings or structures in the City of Boston."

The ordinance provides for the establishment of a Board of Examiners, who will pass on all applications for licenses. John T. Sully is chm. of the present Board of Examiners.

Concrete Organizations, Officials and Conventions

American Concrete Institute, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa. Convention, Chicago, Feb. 16-20, 1914.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Building, Washington, D. C.

American Road Builders' Association, Secretary, E. L. Powers, 150 Nassau St., N. Y. C. Convention and Exhibition, First Regiment Armory, Philadelphia, Dec. 9-12, 1913.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Building, Philadelphia, Pa.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; J. P. Beck, Sec. Seventh Chicago Cement Show, Coliseum, February 12-21, 1914.

Iowa Association of Cement Users, Henry H. Dean, Glenwood, Ia., Secretary.

National Conference on Concrete Road Building, J. P. Beck, 72 W. Adams St., Sec. First meeting Auditorium, Chicago, February 12-14, 1914.

Nebraska Cement Users' Association, Secy.-Treas., Frank Whipperman, Omaha, Neb. Convention Feb. 2-4 and Show Jan. 30 to Feb. 4, 1914, Omaha.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Bldg., Minneapolis, Minn.

The Chicago Cement Show

It has been evident from the first that the decision of the Cement Products Exhibition Co., to hold but one show this winter, and that at Chicago, carried with it the unqualified support of the trade. The demand for space has been so great that the management has found it possible to exercise some discrimination in allotting space to exhibitors who make displays of special interest and importance to the industry. With three months before the opening night of the Cement Show, February 12, 1914, all but half a dozen spaces have been taken by exhibitors. This remarkable demonstration of cooperation and interest is without precedent. In previous years it has been the custom of some manufacturers to withhold their applications until a month or two before the date of the show.

The working out of the installation scheme for the coming show is already under way. A large architectural decorating concern in Chicago has been given the contract for the construction of the principal features of the booths. Instead of the usual arrangement of posts and partitions, large figures and ornamental sign posts will be used with no partition at the back to separate the booths. The sign boards and standards will be cast in plaster according to an ornate design and will support an electric light for each individual booth. It is expected that the absence of high partitions will make for a more attractive exposition. The plan is to get away from displays boxed up in stall-like booths.

Good Roads Conference

The national conference on concrete road building, to be held in Chicago at the time of the Cement Show, has caused several manufacturers of paving mixers and manufacturers of other road building equipment to go into the show. The conference will be attended by road men from all over the country, to take part in the three days' discussion on the construction of concrete roads and street pavements. Over 100,000 state, county and township road officials are to be invited to this conference.

The American Concrete Institute

The unusually large number of associations that will have their annual meetings in Chicago at the same time as the show will bring out a greater attendance. Pres. Humphrey, of the American Concrete Institute. states that the institute program will be more interesting than any ever given by the old N. A. C. U. The next convention will mark the 10th anniversary of this organization and the directors of the institute plan to make suitable recognition of the anniversary by introducing some new features at the convention.

The National Builders' Supply Association

Within the last month announcement has been made that the annual convention of the National Builders Supply Association will be held in Chicago at the time of the Cement Show. Charles Warner, Wilmington, Del., who is the active president, is directing the work of the Association and outlining the program for the annual convention. The Association is the national organization of building material dealers in the country. The conventions are always largely attended and the next meeting promises to be no exception. The problems of the retailer of building materials are to be treated from every standpoint. Other conventions will be those of the Illinois Association of Municipal Contractors, National Association of Sand & Gravel Producers, Interstate Cement Tile Manufacturers' Association and the Illinois Lumber and Builders' Supply Dealers' Association. All of these are important and active organizations.

Los Angeles is a firm believer in the advantages of reinforced concrete and is planning a viaduct on Fourth St. which will cost about $1,000,000, to be built almost entirely of this material.

Water Tower Construction Presenting Unusual Features

In the past few years much attention has been directed toward the most efficient design of concrete standpipes. When the walls of a standpipe expand, due to changes in temperature, pressure, etc., eccentric stresses are set up at the base, and unless precautions are taken to overcome this, serious defects in the structure may develop. At a meeting of the Boston Soc. of Civ. Engrs. several years ago, there was a very complete discussion of this question, the various engineers present bringing up in detail the methods they used to overcome this difficulty.

As a somewhat radical solution of the problem the design described in the accompanying notes has been developed. In this method the cylinder of the standpipe is entirely separated from the base, being connected by a slip joint. The first standpipe of this design is now under construction at Fulton, N. Y.

In an endeavor to design a standpipe which would successfully eliminate the eccentric stresses at the base of the wall due to the expansion of the cylinder and the inability of the base to expand proportionally, William Meuser, of the Concrete Steel Engrg. Co., N. Y. C., worked out several years ago a design for a standpipe in which the cylinder is entirely disconnected from the base. The first standpipe to be built according to this design, and which is patented by the Concrete Steel Engrg. Co., is now under construction near the Mt. Adnah Cemetery, Fulton, N. Y. Bids were received on this work Sept. 25 last, and the contract was let to the A. Monsted Co., Milwaukee, for $24,335. A. D. Whipple is the resident engineer in charge of the work.

General Description and Dimensions

The standpipe has an inside diameter of 40′, and from bottom to overflow a height of 100′. The circular wall is 18″ thick throughout, reinforced with steel bars. It rests on a reinforced concrete base, but disconnected from it by a slip joint. The foot of the wall will be waterproofed against the concrete base by means of a V-shaped gutter to be filled with elastic waterproofing material. The standpipe will be surmounted by a dome-shaped concrete-steel roof having a rise of 10′ 9″, topped with a lantern. The total height of the structure from bottom of base to top of lantern will be 117′ 1″.

Foundation

The surface of the ground before starting operation was practically all level. The excavation in general was carried about 4′ 6″ below grade except at the rim where the foundation was 7′ 2″ deep. Four preliminary test pits were dug near the location of the standpipe which indicated that sand and gravel would be found.

Handling Concrete Materials

The general specifications state that the volumes of sand, gravel, broken stone, etc., in a mixture of mortar or concrete shall be measured loose. Two grades of concrete are called for as follows:

Grade A—1 part Portland cement, 2 parts sand, 4 parts broken stone or gravel that will pass in any direction through a 1½-in. ring, shall be used in concrete for the base, coping and gutter, the roof, battlements and lantern.

Grade B—1 part Portland cement, 1½ parts of sand, [illegible] parts of broken stone that will pass in any direction through a [illegible]-in. ring, for the circular wall.

The sand, broken stone and gravel shall be so graded that in all cases the cement shall more than fill the voids in the sand and the mortar shall more than fill the voids in the broken stone or gravel. If necessary, the ratio of sand to gravel or stone may be slightly altered so as to produce the maximum density of concrete.

The Concrete Base

The foundation on which the standpipe rests is of grade *A* concrete, as specified above. The specifications state that this concrete base shall be built as continuous work, with the exception of the circular outside coping and the gutter to be built later. The upper surface of the base shall have a wearing surface of 1″ thick of mortar composed of 1 part of Portland cement and 1½ parts of crushed granite or trap rock. The specifications require that this surface layer shall be placed simultaneously with the base and before the base shall have time to set.

The Slip Joint

The specifications covering this point state that upon completion of the base and as soon as the concrete is sufficiently hardened, in the estimation of the engineer, that part of the rim of the base upon which the wall will rest shall be covered with a coat of graphite paste about ⅛″ thick, smoothed and pressed hard onto the concrete. In making the paste, only graphite and a satisfactory mineral oil shall be used. Upon this anti-friction paste shall be laid a ring of No. 20 sheet copper, approximately 1/32″ thick and 26″ wide, in sections of convenient length, upon which the wall will rest.

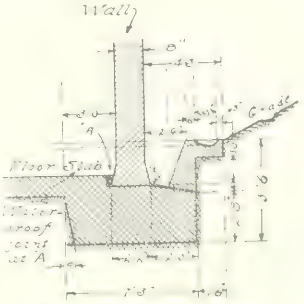
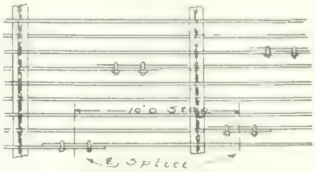
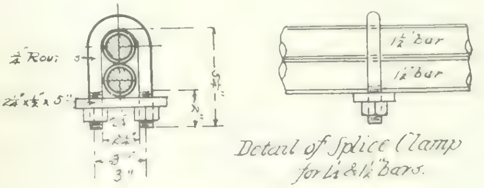


FIG. [illegible]—DETAILS SHOWING SLIP [illegible] AT THE [illegible]





[illegible]

The Standpipe Wall

As shown in the accompanying sketches, the standpipe wall is 18″ thick. Grade *B* concrete, as specified above, is called for and the wall is supposed to be built as a monolith from start to finish. The specifications call attention to the fact that the walls have been made of uniform thickness to simplify the form work. The contractor had the option of building a section of forms of sufficient height to allow for the continual, gradual, upward movement of forms, as the concreting progresses, or to make the forms in horizontal rings, replacing the lower ring on top of the upper ring as the concreting progresses.

The steel reinforcement is so designed that a considerable amount of it may be safely erected before concreting is started. No so-called waterproofing compound is being used in the concrete, but every effort has been made to produce the maximum density of mixture and to carry on the concreting process uniformly around the entire circumference of the wall and continuously until the entire wall is completed. As the removal of the forms progresses the outer surface of the wall will be rubbed down with a carborundum brick and water satisfactory to the engineer.

Continuous Pouring—A Waterproof Structure

As no waterproofing is to be used, it is evident that it is desired to build a waterproof structure using Portland cement and aggregate only, and therefore the cylinder should be strictly monolithic. The contractors, A. Monsted Co., Milwaukee, make a specialty of concrete cylinders of this description, using screw jacks for raising the forms gradually and continuously, thus permitting the pouring of the concrete continuously, so that no seams exist in the tank walls. The progress on the tank walls has been extremely satisfactory, as the 100-ft. height of 40-ft. diameter shell was completed in 20 days and 5 hrs., which is thought to be a world's record for speed on this class of work. The pouring of concrete was carried on by three shifts of men working 8 hrs. each shift and not stopping work for Sundays, holidays, storms nor any other cause. The screw jacks used are known under the trade name of "Odie" jacks and are the patent of A. D. Whipple, Milwaukee, Wis., the contractor's engineer.

There has been a great deal of discussion as to the possibility of building waterproof concrete and nearly all contractors have built occasional examples of waterproof concrete, but generally it has been thought that these were accidents. The fact, however, that satisfactory results were occasionally realized proved the possibility, and both the designers and contractors have been earnestly working to secure waterproof concrete, with the idea of definitely proving in their own minds whether or not it is possible to guarantee waterproof concrete on work of large magnitude.

The Elastic Seal

After the circular wall is completed, the V-shapped gutter between the wall and the base will be thoroughly cleaned ready to receive the elastic seal.[1] The concrete surfaces of the gutter will be perfectly dry before the seal is applied. The seal shall be heated to 350° F. and not over 400° F. and will be poured into place at as near the proper temperature as possible. It should not be allowed to stand in the kettle for any length of time. The seal will be poured all around the standpipe at a gradually increasing height until the V-shaped gutter is entirely filled.

The Roof

The reinforced concrete dome-shaped roof calls for the Grade *A* concrete, as specified above. The concrete will be cast continuously in a monolithic slab. The outside or upper form shall be removed as soon as practicable and the surface rubbed smooth with carborun-

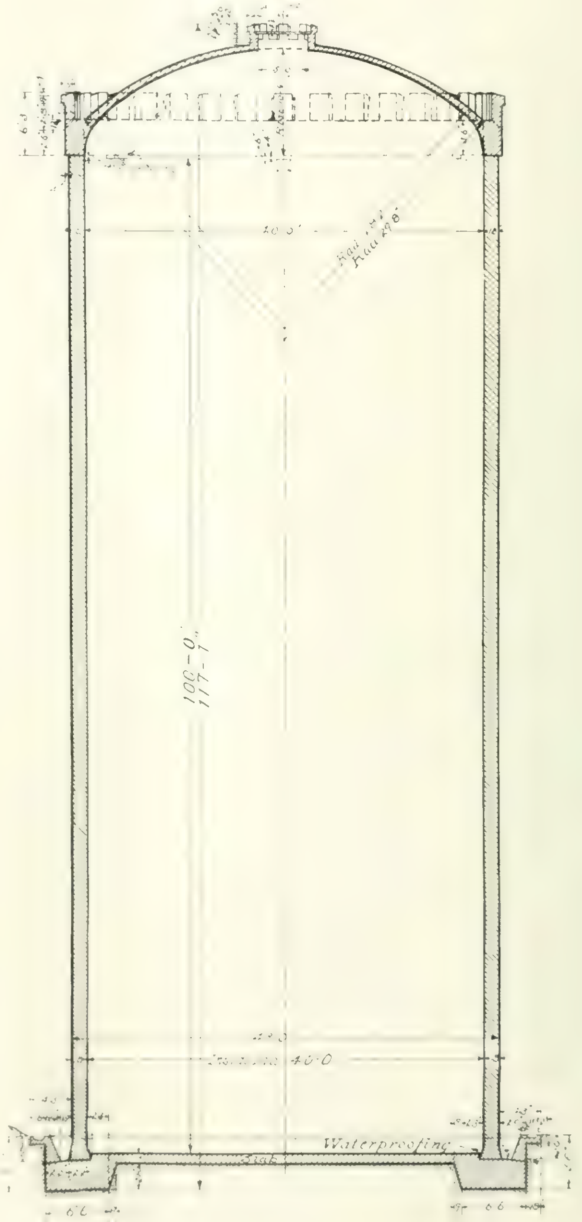


Fig. [illegible]—Vertical Section of a Concrete Standpipe at Fulton, N. Y.

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[1] [illegible] "Positive Seal No. 24," manufactured by the Barber Asphalt Paving Co., Philadelphia, Pa., or equal thereto

dum[1] stone and water. Afterwards the surface will be given a coat of cement wash.

Following is a summary of the quantities of material required for this standpipe:

Summary of Quantities

	Items	Quantities	
1	Excavation	[illegible]	
2	Floor Concrete, 1:2:4	164	
3	Circular Wall Concrete, [illegible]	[illegible]	
4	Dome and Coping Concrete, 1:2:4	80	
5	No. 20 (.032") Sheet Copper, 283 s. ft.	410	lbs.
6	Asphalt Construction Seal [illegible]	[illegible]	
7	Graphite Paste for Slip Joint	[illegible]	
8	18-in. C. I. Water Pipe. 1-12.0' length, 1-¼ bend	3,200	"
9	Reinforcing Bars, estimated weight+5%	264,900	"
10	Angle Posts	[illegible]	"
11	[illegible] U Bolts for Ladder Bars	[illegible]	
12	[illegible] U Bolts for Ladder Bars	[illegible]	
13	[illegible] Special Clamps for Spirals	[illegible]	
14	Ladder	[illegible]	
15	Manhole Frame and Cover		pcs.
16	[illegible] Drain Pipe	[illegible]	

A Concrete Building Disaster in Cedar Rapids, Ia.

The middle of November seems to be a dangerous time for concrete building construction. With but one exception in the last four years have we been able to send the December number to press without recording a failure. Nov. 22, 1910, a building under construction for the Hencke Furniture Co., Cleveland, collapsed, killing four men and injuring seven. This was recorded in *Concrete Engineering* for Dec., 1910. Nov. 15, 1912, a rear section of the roof of a garage being erected for Thos. Cowhey, Detroit, collapsed, killing three men. This was recorded in CONCRETE-CEMENT AGE for Dec., 1912. Nov. 14, 1913, the rear section of the Stark-Lyman Building, Cedar Rapids. Ia., collapsed and, according to present reports, seven men were killed.

This building, which is being erected for the Stark-Lyman Co., by Lauritzen & Wasson, general contractors, Waterloo, Ia., is a seven-story all-reinforced concrete building. It is 60' wide by 140' long. The section that failed was the rear 40', or an area of 40' x 60'. For the floor construction a combination of tile and concrete joists is used. Two rows of columns, approximately 20' apart, and the two rows of wall columns support the interior of the structure. The girders run across the building, dividing the building into a series of transverse bays 60' long, with 20-ft. center to center span.

The building was planned by H. J. Bishop, who was in charge of the construction at the work of the Corn Products Co., Argo, Ill., in 1909. Maybery & Co., Cedar Rapids architects, made the drawings. Before the work started Ernest McCullough, cons. engr., Chicago, checked over the reinforced concrete design which was furnished by William B. Hough & Co., Chicago, who also furnished the reinforcing materials. In justice to Mr. McCullough, it should be pointed out in detail just what his connection with the design of this building was. The owners purchased the steel directly from Wm. B. Hough Co., and according to their design, which followed specifications given to the steel salesman by the owners' engineer, Mr. Bishop. After this steel was on the ground, as an added precaution, the plans were sent to Mr. McCullough, who found that the designer had followed the specifications and that the design was consistent throughout and the details were good.

Specification Requirements

The specifications called for stresses as follows: Steel in tension, 20,000 lbs. per sq. in.; concrete in compression due to bending, 750 lbs. per sq. in.; concrete in direct compression, 600 lbs. per sq. in.; deformation ratio, 15; shear on the concrete, 40 lbs.

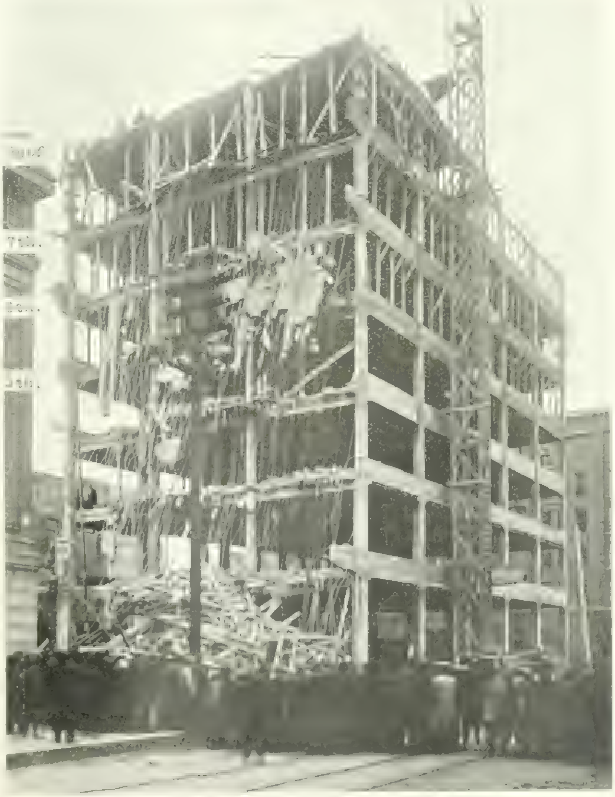
The specifications called for the following live loads per sq. ft.: sidewalk, 250 lbs.; first floor, 125 lbs.; remaining floors, 95 lbs.; roof, 55 lbs. These loads are in addition to the weight of the slab.

Progress of Work

The construction had proceeded uniformly since the work started. Following is a schedule of the floors as poured:

4th floor poured Oct. 4,
5th floor poured Oct. 13,
6th floor poured Oct. 23,
7th floor poured Nov. 1.

When the disaster occurred, Nov. 14, the roof was being poured and concrete was being placed in the rear bay above a point where the failure probably originated. The contractors state that three complete sets of forms were used on the work, which would indicate that the forms were taken out from under the fifth floor to center up the roof, leaving the slab on the fifth floor, poured Oct. 13, without support. It is stated, however, that the shores were in place under the beams of the fourth and the 5th



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[1] Carborundum Co., Niagara Falls, N. Y.

floor, although the slab supports had been taken out.

The following notes show the report of the Weather Bureau for minimum temperatures in Cedar Rapids from Oct. 1 to Nov. 14.

[illegible] AR RAPIDS, IA., OCT. 1 [illegible] NOV. 14, 1913

[illegible]	Maximum	Minimum	Mean
[illegible]	[illegible]	50	62
2....	[illegible]	[illegible]	56
3....	[illegible]	43	61.5
4	[illegible]	60	64.5
[illegible]	[illegible]	63	71
[illegible]	[illegible]	57	[illegible]
7....	[illegible]	53	59.5
[illegible]	[illegible]	54	[illegible]
[illegible]	[illegible]	59	69
[illegible].....	78	39	58.5
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	58
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	50	53
[illegible]	[illegible]	45	[illegible]
" 16....	[illegible]	[illegible]	45
[illegible]	[illegible]	35	[illegible]
[illegible]	[illegible]	34	44
[illegible]	[illegible]	32	37.5
[illegible].....	39	[illegible]	30.5
" 21....	[illegible]	24	30.5
[illegible]	[illegible]	27	33.5
[illegible].....	54	28	41
" 24....	[illegible]	34	48
[illegible]	[illegible]	39	50.5
[illegible]	[illegible]	[illegible]	34
" 27....	[illegible]	25	34.5
" 28....	[illegible]	27	37
[illegible]	[illegible]	28	[illegible]
[illegible]	[illegible]	20	27.5
[illegible]	[illegible]	21	30.5
Nov. 1	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	48
" 3....	57	31	44
[illegible]	[illegible]	28	[illegible]
[illegible]	[illegible]	[illegible]	44
[illegible]	[illegible]	47	53
[illegible]	[illegible]	35	[illegible]
[illegible]	[illegible]	26	32.5
[illegible]	[illegible]	20	30
" 10....	[illegible]	18	[illegible]
" 11.	[illegible]	18	35.5
" 12	61	31	46
" 13....	[illegible]	30	37.5
" 14	44	30	37

From the best information available now it would seem as though no precautions were taken to guard against the effect of temperatures while the construction was going on.

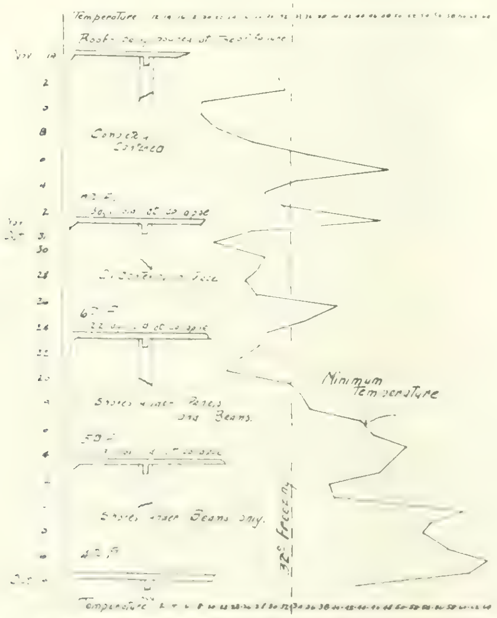
The Collapse

When the floor started to go it went very quickly and the men on the roof were carried down with the wreckage. William Lowe, the contractors' superintendent, and the foreman, were among the killed.

In the wild anxiety to get at the bodies and rescue any workmen who might be still alive, most of the debris was, of course, removed before engineers from Chicago could reach the city. An oxy-acetylene flame was employed successfully to cut the reinforcing.

Explanations of Failure

There are three possible explanations of the failure, which are offered at present. H. J. Bishop, superintending engineer for the owners, states that the forms under the roof broke. It is also stated that it may have been due to a failure in foundation; old residents of the city claim that there is an old filled-in water course under part of the building that failed. Another suggestion is that there may have been a possible failure of the slab in the center of the bay on the fifth floor, which was poured Oct. 13. A concrete building when it is being rushed to completion as this building was and at that particular time of the year, is very much like a house of cards; failure of a smaller portion of the floor slab—say on the fifth floor—would immediately cause the failure of all work directly above it in a terribly cumulative manner, for each floor above is weaker than the one below, and then, with constantly increasing violence, the failure is spread, until the entire structure is sucked down into a tangled mass of wreckage.



[illegible] DIAGRAM SHOWING [illegible] OF FLOORS, TIME OF POURING, AND THE MINIMUM TEMPERATURES FOR SIX WEEKS PRECEDING THE STARK-LYMAN BUILDING COLLAPSE, CEDAR RAPIDS, IA.

Lessons From the Failure

It is impossible at this time to point out what might have been the cause of this failure; it is much more to the point to emphasize the great need of caution and extra care in handling concrete as the cold weather approaches. On *winter* concrete work, every precaution is taken and failure is almost eliminated, but it is along in the *fall months* when the *nights* are cold and the aggregate may be wet that setting is delayed, and extra precautions must be taken.

The part of the building still standing is apparently uninjured and from all indications the concrete has been handled in a workmanlike manner.

Additional Notes on the Stark-Lyman Building Failure

Since the above notes were prepared the following comment by an engineer thoroughly familiar with the work have been received. It is a running comment on the above paragraphs and on the disaster as a whole:

It can be stated definitely that there were on forms under the fifth floor which, consequently, was carrying the weight of the sixth floor and the seventh floor. This imposed on the fifth floor a superimposed weight of about 150 lbs. per sq. ft. Assuming that the weight of the forms and the centering equaled the dead load on this floor, it can be seen that the floor was loaded to about double the design load, which would stress the steel at about 40,000 lbs. and the concrete at about 1,500 lbs. From the appearance of the concrete at the time of the accident it is to be doubted very much if it had an ultimate strength of 1,500 lbs. With this load on the fifth floor, concreting operations began on the roof, with their terrible result. From the best information available it is believed that the fifth floor gave way first. In conversation with workmen who were on the sixth and seventh floors and on the roof, and who managed to escape, the reports seem unanimous that the floors gave way *below* them, and the failure did not originate above.

The theory that a shore snapped under the roof load should not be entertained. The breaking or bending of one shore or the giving way of a few form boards would result in pouring a little wet concrete over the floor below, a damage which could easily and quickly be repaired. To say that the giving way of roof forms caused the accident would mean that each and every post under the roof gave way simultaneously, a manifestly absurd supposition. A careful examination of the illustration will indicate some shores on the fourth floor. They, however, were under the beams and not under the slab. If there had been centers under the slab of the fourth floor as there were under the fifth, the accident might not have happened.

Possibility of Column Failure

It has been suggested that a column might have collapsed, but a careful investigation of the column stresses shows that if the concrete at the time of failure had been good for only 1,000 lbs. per sq. in., the columns were safe. The columns between the fourth and the fifth floors became long slender columns when the fifth floor gave way, and under such circumstances, of course, they failed.

Sills for Shores Essential

The vital point in the failure seems to be that the load of the shores on the fifth floor was not uniformly distributed by resting the verticals on wide, heavy planks laid across the concrete joists. As it was, small blocks were used under each shore. This resulted in concentrated loads about 4' o. c. each way over the floor, amounting to about 2,200 lbs. load per individual shore on the fifth floor. This would give a punching action to the shore very destructive to green concrete.

The Verdict

The coroner's verdict, which was announced Nov. 25, is to the effect that the building failed because the work was pushed too rapidly; considering weather conditions, the concrete was not given time to set and forms were removed too soon.

The failure can be charged to the time of the year and the lack of precautions to guard against the effect of temperature in slowing up the setting action of the concrete. Even if the stresses advised by the Joint Committee had been used the disaster, under the circumstances, would have occurred.

Concrete Houses at Midland

At Midland, Pa., the Crucible Steel Co is casting all-concrete cottages using steel forms with batch mixers and gravity chutes. The system of steel forms used, developed by F. D. Lambie, pres. The American Bldg. Corp., N. Y. C., consists essentially of steel plates 12" wide and 8' or more high. The floors are cast using the same steel plates, horizontal structural steel, channels or angles and ledgers. The houses being cast at present, are the first group of an extensive development.

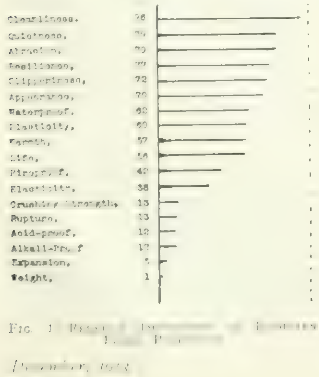


FIG. 1 [illegible]

An Analytical Study of Composition Floors*

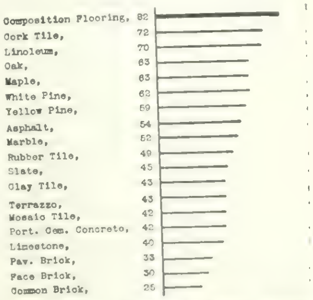
BY H. M. HOOKER

These notes are the issue of a two years' investigation of composition flooring involving a personal study of work and manufacturing methods in the U. S., Germany, France, England, Belgium and Austria. They aim in some measure to serve two main purposes, to spread more accurate information as to composition flooring and its characteristics, and to provoke and stimulate a much more careful and scientific study of flooring problems.

For the last half century an improved flooring and surfacing material has been steadily sought in every civilized country. Many chemists and workers in Germany, in the U. S. and in other countries have seen bright prospects for progress in the use of magnesia cement products, and particularly in Germany have worked with varying success toward a more and more perfect flooring surface. The result is the so-called composition flooring that is rapidly extending in use today.

History

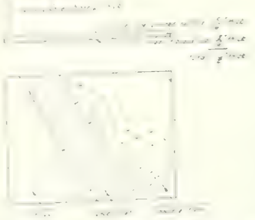
The history of this material, like that of many another, has been one of apparent early success, failure, disappointment, advance and ultimate commercial success. The basic process was worked out, or at least given to the world, in 1866, by Stanislaus Sorel of Paris, France, who then took out patents on a cementing material composed of magnesia and chloride of magnesium as the two chief ingredients to which other powdered substances could be added. Somewhat later "Sorel Stone" was widely hailed as a valuable addition to the building resources of our own and other countries. Experience and use, however, make it clear that the weathering and enduring properties necessary, particularly for exterior use, were missing and Sorel Stone failed of its early promise. It was not there with the staying qualities. But chemists, manufacturers and workers had been given a suggestion, a working basis for study, experiment and effort. From Sorel's basic compound they have developed a permanent floor surface by the addition and treatment of different ingredients. Some 120 different chemicals and some 88 formulas have been tried out commercially in this country alone. It is mainly due to the German chemists, however, that a really desirable commercial material has been evolved. Gradually, through improvement, failure and again improvement, the border between a doubtful and a really desirable flooring material was crossed. This occurred about seven years ago, and since that time most of the German manufacturers, and there are now 150 of them, some of the English and the American manufacturers have been furnishing a durable, desirable material



[illegible]

General Description of Composition Flooring

Composition flooring is a light-weight, fireproof, resilient covering. It is laid plastic, usually about ½ in. thick, and sets in a few hours into a seamless, tough, warm and rather quiet mass; in appearance and feel not unlike high-grade battleship linoleum. Its jointless character and comparative freedom from cracks due to warping, uneven settlement and vibration of buildings give it special sanitary value. It is laid over wood, metal, or concrete, and adheres firmly thereto. It appears in many colors and combinations of color from black to a light pearl gray. Probably 98% of the work, however, is red, buff, or gray. In general, colors other than these three are utilized for borders, ribbons and special designs only. Mineral pigments are used almost universally, and, except in the blues and greens, the colors are fast. Blues and greens in the course of years fade to much lighter shades than when first installed. This fading detracts somewhat from the appearance of the work, but does not accompany any appreciable deterioration in wear or life.



[illegible] AND BASE INSTALLATION ON CONCRETE FLOOR

Field of Use and Usefulness

From the start magnesia cement flooring has attracted attention primarily because of its sanitary qualities. These it combines with a warmth, resilience and degree of quietness not possessed by concrete, tile or terrazzo. It was first installed in hospitals, schools, asylums, public and semi-public buildings.

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*[illegible] Structural [illegible] Pa., Sept. 9, 1913

[illegible] loid Co.

Its use in buildings of this character has extended more and more rapidly during the past few years so that there are today probably not less than 6,000 such installations in this country. It was then laid and tried out with a favor that has steadily gathered momentum in other places where cleanliness has been a chief desideratum. I refer to restaurants, dairies, candy factories, hotels and the service parts of residences.

To enumerate all of the classes of buildings in which it has been used with some satisfaction would be to mention practically every type of fireproof building in existence. The following are, however, types in which it has to date demonstrated great usefulness: hospitals, schools, institutions, power plants, stores, dairies, restaurants, hotels, industrial plants, firehouses, garages and th service parts of residences.

It is extensively used for wainscot, base, both treads and risers of stairs, trim and even ceiling. It is as a flooring, however, that such a material is subjected to the severest use, and for this reason the discussion will be concentrated upon its floor value.

Physical Characteristics and Properties

Manifestly the usefulness of any flooring material rests in its physical characteristics and properties. The engineer or architect who chooses wisely narrows his option to proved materials. He then applies common sense and makes a more or less thoughtful, considered selection of the material which will, according to the data available, best answer his purposes. If he has been even slightly thorough he has faced many factors, each of inconstant value, varying with the use to which the flooring is to be subjected, but each of which must none the less play its part more or less consciously in the final determination. What are the properties that he must weigh in an even semi-scientific appraisal? I find no less than 18 important factors. They are:

1. Cleanliness—Sanitary Characteristics.
2. Quietness.
3. Immunity from Abrasion.
4. Resilience.
5. Immunity from Slipperiness.
6. Appearance.
7. Degree Waterproof.
8. Plasticity.
9. Warmth—Thermal Insulation.
10. Life—Immunity from Deterioration with Age.
11. Degree Acid-proof.
12. Degree Alkali-proof.
13. Fire-resistance.
14. Elasticity.
15. Crushing Strength.
16. Structural Strength.
17. Immunity from Expansion and Contraction.
18. Lightness.

Under some conditions appearance is of prime importance; under others, cleanliness; under others, freedom from abrasion. But for the great majority of flooring conditions the relative value of each factor corresponds to its place in the above list. A closer relative valuation is to be found in Table No. 1.

The above table represents a valuation placed upon each characteristic after weighing it under 14 standard conditions of use in restaurants, toilets, factories, hospitals, schools and residences. No doubt every thoughtful appraiser will use slightly different figures. The general results, I believe, closely approximate those here given.

Comparison of Composition Flooring with Other Standard Materials

In the discussion 19 flooring materials have been ranked in 18 different relations. But what, summing it all up, is the relative worth of each flooring material under conditions of normal usage? What value must we assign to each? Manifestly, the figure will vary with the use to which the floor is to be subjected, and any floor problem should be weighed with its special conditions in mind. Most floors will approximate one of the fourteen types already discussed. In that event if my appraisals are just, the computing of the value of each flooring material for the place is merely a matter of arithmetic. (See Table No. 2.) These data yield the following batting averages:

At the first glance it may be somewhat startling to note that even regardless of cost composition flooring ranks above all competitors and some 9% above cork tile, its nearest rival. Were it a freak, or an old material adapted to a new use, this would be indeed surprising. But under the conditions of its birth and growth it is but natural. Composition flooring is the issue of prolonged scientific effort. The properties most to be desired in a flooring were repeatedly determined and checked by analysis, observation and experiment. A wide range of materials possessing these properties was assembled in different proportions. The synthetic building up of a composite material possessing a happy blend is the outcome. Composition is the result of a successful attempt to jump its competitors' liabilities while bringing their assets into chemical bond. It is not the product of one brain or of one year, but the issue of a number of years of effort on the part of several hundred chemists and several thousand workers under varied conditions in many countries.

Conclusion: Composition flooring is the issue of scientific effort to incorporate in a flooring the physical characteristics most to be desired for any given conditions. It is already a valuable material. Like steel, concrete and artificial slate for many purposes, it is of greater value than any of its ingredients. How rapid its extension in use will be and what integral improvements the future has in store depend upon many factors. Practically everyone who has given it careful study is convinced that it will soon be generally recognized and extensively used as one of the valuable, standard building assets of this country and the world.

Concrete Block Silo to Hold 325 Tons Cost $625

The Charles Kline silo, shown in the accompanying illustration, is 18′ in diameter by 48′ in height. It is built from 8-in. continuous air space anchor block[1] and plastered on the inside with a thin coat of cement mortar and brush-coated with clear cement similar to first-class cistern construction. It is reinforced with ¼-in. twisted steel rods every 8″, and it has steel doors and door frames and ladder attachment.[1] The doors are perfectly smooth on the inside, hinged, and swing inward. Size of the doors is 2′ x 2′, made from ⅛-in. steel, and between the steel door proper and the jamb, which is of 1″ x 1″, quarter-in. angle, there is a cushion of ⅜″ of ground cork. When the doors are locked with eccentrics they are air-tight as well as water-tight.

The roof on the silo is built of reinforced concrete 4″ in thickness, reinforced with ¼-in. twisted steel bars every 6″, running around the roof. The steel bars are held in position by flat spacing bars and are held 1″ from the wood frame. Height of the roof in center is 5′. The coping stone is made 16″ wide, 2′ in length and 4″ in thickness. The silo holds 325 tons of silage and it took 35 acres of heavy corn to fill it. The silo starts 4′ below the ground level. Its cost complete was $625.

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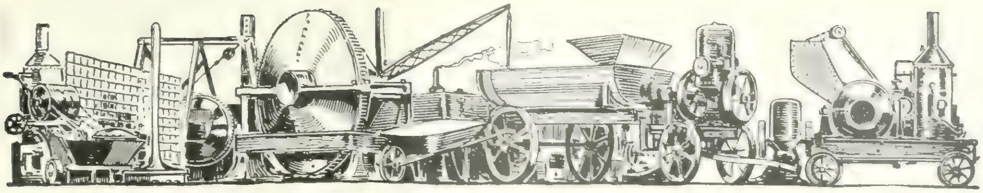
[1] Anchor Concrete Stone Co., Rock Rapids, Ia.

ANCHOR CONCRETE SILO



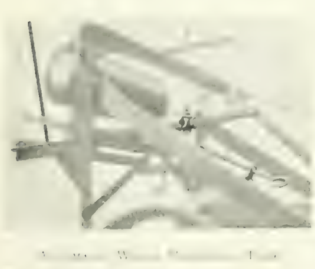
New Equipment, Methods and Materials

The forward progress of any industry is measured by the tools with which it works, and the engineer-manufacturers who are developing new and better methods and materials, merit recognition and co-operation. In this department are published brief descriptions of the new developments of the field

An Automatic Water Tank for the Small Batch Mixer

The water tank on the "Wonder" mixers, manufactured by the Waterloo Cement Machy. Corp., Waterloo, Ia., is connected with city water pressure at *H* as shown in the illustration. The pull of a lever within easy reach of the operator opens the 3-way valve *I* and fills the tank. Reversing the lever shuts off the supply and discharges the contents of the tank into the mixer. When the tank is empty the lever is reversed and the tank refills for the next batch. The amount of water wanted for each batch may be regulated by raising or lowering the tank at the graduated scale *J*. The higher the tank is tilted on this scale, the less water will be fed into the mixer. Once set, it is unnecessary to shift the angle of the tank unless it is desired to change the quantity of water per batch of concrete. When city water pressure is not available a rotary pump is provided and connected with the gasoline engine. A relief valve in the top of the tank takes care of surplus water, which is conducted by hose back to the barrel or other source of supply.

This tank measures the water for each batch accurately and positively. It effects great saving of time over old methods and insures absolutely uniform concrete. When, as often happens, work is started in the morning with wet sand, and, later on, dry sand is encountered, the tank is easily adjusted to changed conditions, and uniformity of the concrete is thus preserved.



Automatic Water Measuring Tank

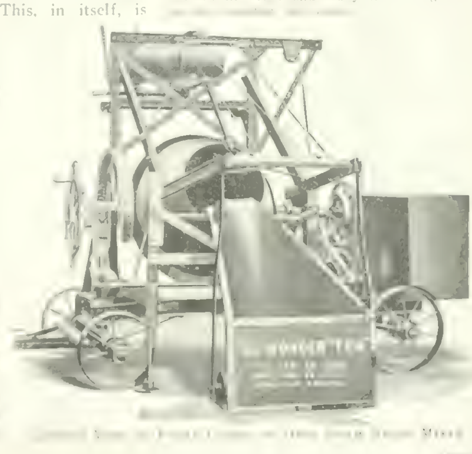
New Features in Small Batch Mixers

Two improvements of value in its line of concrete mixers—the "Little Wonder Five" and the "Wonder Ten"—are announced by the manufacturer, the Waterloo Cement Machy. Corp., Waterloo, Ia. The most important of these is the new power loading attachment. In the construction of this the supporting steel frame is strong, of small height and well braced. The bucket or scoop rests at the ground level for loading by shovels or barrows. The bucket is raised and lowered by a wire cable attached to a helix clutch hoist, and thence through sheaves at the top of the loader frame and at the shackle-bar. The bucket can be held in suspension at any point, whether loaded or empty, by means of a brake.

Operation of Side Loader

In operation the sand and stone are shoveled or dumped into the bucket in proportions proper for the batch and the cement added. The pull of a lever then raises the bucket to almost an inverted position and the contents are discharged into the drum. Owing to the very wide mouth of the drum, it is unnecessary to choke or narrow down the neck of the loader bucket, with the result that the material slides easily and rapidly into the drums without poking or pounding. This, in itself, is a valuable feature. All control levers are within easy reach of the operator. The [illegible] bucket does not impede movement about the job as it can be elevated to a nearly vertical position for this purpose. The bucket is also easily detachable for shipment.

By reason of the light weight and easy portability of these mixers, it is often possible to discharge the concrete directly into the forms. [illegible] [illegible] the [illegible] and speed of the work with a machine, equipped with this power loader, are quite remarkable. The extra initial investment required for the power loader appears to be one that returns large dividends to the purchaser.



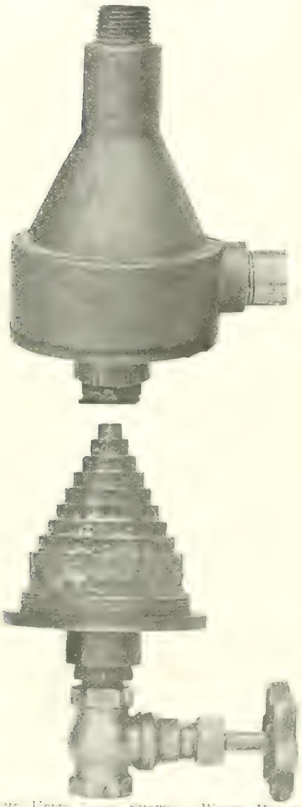
[illegible]

The Hydrozo Paint Mfg. Co., Kansas City, Mo., has completed arrangements with the Standard Paint and Varnish Co. Ltd., Windsor, Ont., whereby the latter will manufacture Hydrozo in Canada to meet the Canadian demands for this material. "Hydrozo" is a non-oxidizing mineral wax preparation which is applied to concrete surfaces as paint in a gasoline or naphtha solution. Applied in this way it develops to a considerable depth, the manufacturers state, a permanent non-capillary condition of the concrete surface. This material is being used successfully on structures of many types.

Stone Carriers. Ruggles Mach. Co., Poult-[illegible] carrier. These cable carriages are used extensively in slate and stone quarries for handling material and will run by gravity on an inclination of 15%. With the automatic feature this carrier will lift a load from any depth up to the cable, the carriage is placed automatically, released and proceeds by gravity to the desired spot, where the load is auto-[illegible]. The essential features of this carrier are described in detail and many interesting notes [illegible]

A Water Heater for Cold Weather Work

In handling concrete work in cold weather it is customary to heat the water used for mixing the concrete, and while, heretofore, it has been usual practice where steam was available to run a steam line into the barrel of water, letting it exhaust near the bottom, yet with our modern side-loading mixers and automatic water measuring tanks, some other methods of heating the water should be available. The accompanying illustrations show the "Starwal" heater for concrete mixers and for any place where hot water is required. This heater, manufactured by the Warner-Reiss Sales Co., St. Louis, consists of a conical outer shell, inside of which is a perforated cone. The water is admitted at the side of the outer shell, forming a thin wall of water around the inner cone. The steam is admitted at the base of the cone and is sprayed into the thin wall of water through the perforations.



The Upper View Shows a Water Heater Assembled. Below is Shown the Cone, Which Screws Up Inside the Casing

The steam connection is, of course, in the base of the cone. The water is instantaneously heated by its complete mixture with steam. There is no waste of heat

Heating water in this way uses practically every heat unit in the steam and can be easily controlled, as the heat developed is directly relative to the amount of steam admitted. To control this equipment all that is necessary is to have a steam connection and a water connection to the heater, with valves on each and a free discharge into the tank on the mixer. The heater is then ready for operation, and the flow of water can be adapted to the tank equipment used for this on any standard mixer.

When the capacity of the heater is more than is required for the mixer, the valves are not opened to their greatest aperture. When hot water is required for other purposes, as for mixing mortar, a T-connection can be made to the discharge and a line run as desired.

These heaters were first used by James Stewart & Co. for heating water for the concrete on the construction of the M. K. & T. freight house work in St. Louis in the winter of 1910. At that time the heaters were being experimented with, but since that time they have come into wide use among the bigger contracting firms who handle concrete work in winter.

Catalogs and other Trade Publications

Test Data on Fireproof Floor Construction. Clinton Wire Cloth Co., Clinton, Mass. 9¾" x 6¾", paper bound, 35 pp., illus. This is a complete report of the test which is described on page 169 of CONCRETE-CEMENT AGE for Oct., 1913.

Composition Roofing. Vulcanite Roofing Co., Chicago, 8½" x 5½", paper bound, 26 pp., illus. This is a well-prepared booklet, presenting in a comprehensive manner a good deal of detailed information on Vulcanite roofing. Some interesting tests are shown.

Keene's Cement. Best Bros. Keene's Cement Co., Medicine Lodge, Kans. 9" x 5", paper bound, 28 pp. This booklet describes in detail what Keene's cement is and how it is made, differentiating especially between Keene's booths and switchmen's houses are also described.

Concrete Products for Railways. C. F. cement and hard wall plaster. Complete specifications for plastering, ornamental work, finishes, etc., are published. There is also quite a little useful information on painting over Keene's cement, on cost of materials and Massey Co., Chicago, 6" x 3½", paper bound, 32 pp., illus. This is an interesting little booklet describing in detail the essentials of good reinforced concrete pipe manufacture, designed especially for railroad use. Portable telephone labor, etc.

Lever Shears. Thomas Carlin's Sons Co., Pittsburgh. 12" x 9", paper bound, 32 pp., illus. This catalog describes a complete line of power shears from a giant cutter with a capacity of 6-in. square steel and with knives 32" long, to a small power shear with 8-in. knives and a capacity of steel 1" x 1". This smaller machine could probably be used where a large number of concrete reinforcing bars have to be cut. It requires 4 h. p. to 6 h. p. weighs 4,200 lbs. and takes up a floor space 41" x 55".

Safety Hoists. Hall Mfg. Co., Monticello, Ia. 9" x 6", paper bound, 32 pp., illus. This hoist is essentially a block in which a shoe of an eccentric clutches the free end of the rope. This tooth shoe is so arranged on a cam that it is applied or loosened according to the direction of the pull end of the rope. This hoist in many of its forms is used in handling concrete products, setting concrete materials, heavy stones, etc. The locking arrangement comes in very handy at many points.

Cement Facts. Lehigh Portland Cement Co., Allentown, Pa. 6¾" x 5¼", paper bound, 8 pp. This compact booklet presents in a concise way some notes on making concrete, which should be of interest to all men meeting these problems.

Locomotive Cranes. Link-Belt Co., Chicago. 9" x 6", paper bound, 32 pp., illus. Locomotive cranes are coming into more and more general use on concrete construction work. On bridge work described in one of the past issues of CONCRETE-CEMENT AGE cranes were practically essential to the economical conduct of the work. The booklet referred to describes the features of the "Link-Belt" crane and shows many interesting photographs of recent installations.

Belt Conveyors. Link-Belt Co., Chicago. 9" x 6", paper bound, 62 pp., illus. Belt conveyors have in the last few years demonstrated their efficiency and economy in handling bulk materials. This booklet outlines development in belt conveyor practice, discusses why belts fail and presents many interesting notes on capacity and speed, flexibility, inclination, etc. Several valuable tables and photographs of installations are shown.

Unit Forms. American Concrete Form Co., N. Y. C. Poster 20" x 28". This poster shows many interesting uses of this unit panel form, together with perspective sketches showing the essential feature of the form.

Portable Wagon Loaders. Link-Belt Co., Chicago. 9¼" x 6", paper bound, 8 pp., illus. This booklet describes the many types of wagon loaders made by this company and gives interesting information making for economies.

Conveyors for Sand, Stone, Gravel, etc. Link-Belt Co., Chicago. 9" x 6", paper bound, 32 pp., illus. Handling sand, gravel and cement economically is a question facing every contractor, big and little, every time a piece of work is laid out. This catalog shows many interesting concrete plant installations and describes in detail the equipment used.

Steam, Water and Air Flow Meters—General Electric Co., Schenectady, N. Y., 10½"x8", paper bound, 56 pp., illust. This bulletin is a very valuable and comprehensive treatise on flow meters in general and covers in detail many interesting installations of flow meters for water, steam and air. The different types of flow meters are described in detail and many pages are given over to tables of valuable data.

Engineering Instruments—Kolesch & Co., N. Y. C., 9¼"x6½", cloth bound, 336 pp., illust. This catalog, well bound in cloth, describes a complete line of engineering and technical equipment. Everything required in a drafting room and in the engineering field is described in detail.

Plants for Washing Sand and Gravel—Raymond W. Dull Co., Chicago, 10"x7", paper bound, 40 pp., illust. Clean materials are essential for good concrete work, and sand and gravel washing equipment is of prime importance to all concrete engineers. This catalog describes in a comprehensive manner the design and installation of efficient gravel washing equipment. The subject is presented in detail and brief descriptions of many actual installations make the booklet of real engineering interest.

Steel Sash—Trussed Concrete Steel Co., Detroit, 10¾"x8", paper bound, 112 pp., illust. This catalog presents not only complete technical information and construction details but many photographs and reproductions of actual installations of steel sash. The subject is presented very comprehensively and the catalog demonstrates in a most emphatic manner the wonderful strides that have been made in better construction.

How to Construct and Maintain Permanent Roads—Jasper N. Patrick, Chairm. Bd. of Supervisoirs, Napa County, Cal. Pub. by the Port Huron Thresher and Engine Co., Port Huron, Mich., 6¼"x3½", paper bound, 20 pp., illust. This is an interesting little pocket pamphlet which is a reprint of an address delivered at Stockton, Cal., by Jasper N. Patrick, Chairman Board of Supervisors, Napa County, Cal. It covers in a detailed and straightforward way the problems met with in road work in that vicinity.

Hollow Wall System—W. T. Redman, Brentwood, Md., 11½"x8", paper bound, illust. This little leaflet presents the essential features of Mr. Redman's form. The cores are an ingenious arrangement of boxes with inclined ends which are placed in the wall as it is poured and then removed, thus producing a hollow wall tied together at suitable spacings with concrete struts.

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